03.03-08/28/96-00886

# FINAL
# WORK PLAN
# FOR
# FIELD SCALE TREATABILITY STUDY
# YORKTOWN NAVAL WEAPONS STATION
# YORKTOWN, VIRGINIA

Prepared for:

DEPARTMENT OF THE NAVY
Contract No. N62470-93-D-3032
Atlantic Division
Naval Facilities Engineering Command
6500 Hampton Boulevard
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August 28, 1996
Delivery Order 0113
OHM Project 18757WP

OHM Remediation Services Corp.
A Subsidiary of OHM Corporation

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# *EXECUTIVE SUMMARY*

OHM Remediation Services Corp. (OHM) will construct a bioremediation cell approximately 86 feet by 150 feet by seven feet deep. This cell will be double lined with 60 mil HDPE on the bottom, a geonet inner, and 80 mil HDPE on the top. In addition, OHM will construct two concrete footings, approximately 1½ feet by two feet by 150 feet in length. These footings, constructed of 3,000 psi concrete with two #5 rebar running longitudinally, will be positioned on each 150 foot edge of the excavation. They will provide a footing for the gantry rail system (supplied by J.R. Simplot and installed by OHM with Simplot supervision), as well as an anchor trench for the liners.

Subsequent to the installation of the rail system, OHM will supply a 35 ton crane with operator to assist Simplot personnel with the set up of the gantry system, which will operate on the rails.

After the system has been set up, OHM will commence excavation of approximately 500 cubic yards of contaminated material from Site 7. This contaminated material will be brought by truck to a screener, supplied by OHM. After being screened, the material will drop onto a conveyor, which will discharge directly to the J.R. Simplot-supplied "fluidizer," where it will be mixed with water and pumped into the lagoon for bioremediation.

After the Site 7 excavation is completed, as determined by the Navy construction representative, OHM will backfill the area, add a layer of topsoil to grade, and hydroseed the area with erosion control matting, stapled in place over the hydroseed.

# 1.0 INTRODUCTION

OHM Remediation Services Corp. (OHM) has been retained by the Department of the Navy, Facilities Engineering Command (NAVFACENGCOM), Norfolk, Virginia, to perform a treatability study of explosives contaminated soil at Site 7, and a bioremediation cell construction at Site 22, Yorktown Naval Weapons Station (Yorktown NWS), Virginia.

The treatability study consists of the excavation of approximately 500 cubic yards of explosives contaminated soil at Site 7. The excavated soil will be transported by dump truck to a screening operation at Site 22. Subsequent to screening, the material will be conveyed to the "fluidizer" supplied by J.R. Simplot. After mixing with water, the material will be pumped to a double-lined bioremediation cell, constructed by OHM and operated by J.R. Simplot.

This planned action is consistent with the plan developed by Baker Environmental. The Work Plan describes the procedures to be followed by OHM in performing this work.

OHM's scope of work can be summarized as follows:

1. Prepare site and install erosion and sedimentation controls at Sites 7 and 22
2. Excavate bio-cell
3. Install dual HDPE liner system
4. Excavate and form footings for gantry rail
5. Pour 3,000 psi concrete footings
6. Install anchor bolts in concrete footing and install and grout rail
7. Erect J.R. Simplot gantry equipment on rail system
8. Excavate approximately 500 cubic yards of explosives contaminated soil from site 7, under the direction of the Navy construction representative
9. Transport excavated material to Site 22 via dump truck
10. Screen 500± cubic yards of explosives contaminated soil at Site 22
11. Load screened, contaminated soil into J.R. Simplot-supplied "fluidizer"
12. Convey rock and debris from screening operation to the apron of the bio-cell
13. Decontaminate screener debris on the bio-cell apron, using high pressure steam cleaners
14. Transport resultant uncontaminated debris to a stockpile at Site 22
15. Perform site restoration activities at Site 7 (backfill, loam, hydroseed, and erosion control matting)
16. Perform project management in accordance with delivery order and program requirements
17. Coordinate with Base personnel and other contractors
18. Perform quality control testing to document compliance with specifications

Specifically excluded from OHM's scope are the following tasks, which are integral to the success of the project:

1. Perform post-excavation sampling
2. Delineate waste limits

The conceptual approach to this project has evolved from a number of draft submissions, several meetings with regulators and technical personnel, the specifications, drawings, and other miscellaneous information provided during this submittal.

## 1.1 SITE DESCRIPTION

Site 7 is located at Yorktown NWS, Virginia, and consists of approximately 500 cubic yards of explosives contaminated soil. The actual area of excavation will be delineated in the field by Baker or Navy personnel. The area will be excavated to a depth not to exceed three feet, due to existing groundwater conditions. It may not be necessary to excavate to the three foot level, based on field test kit conditions at the time of excavation.

Site 22 is located approximately ¾ of a mile from Site 7, and is the location of the bioremediation cell construction. The cell will be constructed to a depth of seven feet and an overall size of approximately 86 feet by 150 feet. In addition, Site 22 is also the area where OHM will screen the contaminated soil excavated from Site 7, and where J.R. Simplot will "fluidize" the screened soil prior to its being pumped into the bioremediation cell.

## 1.2 CONTAMINANTS

The contaminants present at Site 7 have been identified as follows:

- 2-4-6 TNT up to 20,000 mg/kg
- RDX up to 14,000 mg/kg
- HMX up to 3,200 mg/kg
- Amino-DNTs up to 84 mg/kg

# 2.0 RESOURCES AND PROJECT ORGANIZATION

This section details the equipment and materials which OHM anticipates utilizing during the source removal at Sites 7 and the cell construction at Site 22.

## 2.1 EQUIPMENT LIST

- Stake-bodied truck, pick-up truck and van
- Case 580 Rubber-tired backhoe
- CAT 225/325 excavator
- Morbark 150004/chipper
- CAT D-3 bulldozer
- CAT D-6 bulldozer
- 6 CY dump truck
- Case 586E forklift
- Ditch Witch 3500
- D.D. Roller, wack behind
- JD 644/R.T. loader
- CAT 963 track loader
- Power screen
- 3,000 PSI pressure washer
- Roll off containers

The equipment listed above will either be OHM-owned equipment from the Windsor, New Jersey operations center or will be rented from local vendors. Not all equipment listed above will be present on site for the entire duration of the project. In the event that specific pieces of equipment are not available, OHM will use equivalents.

## 2.2 MATERIALS LIST

OHM anticipates utilizing the following materials on site:

- Straw bales
- Seed/fertilizer/mulch
- Silt fence
- 3,000 PSI concrete
- Sand
- Backfill Material
- 16 oz. Geotextile
- Topsoil
- Poly cover
- High-visibility safety fence
- 60 Mil HDPE
- 80 Mil HDPE
- Geonet inner
- Anchor bolts and nuts
- Backflow preventer
- Grout
- Erosion control mat with staples

## 2.3 MANPOWER REQUIREMENTS

OHM will mobilize a crew that will perform the excavations and backfilling at each of the sites; and coordinated transportation and disposal crews will be mobilized from OHM's Trenton, New Jersey and Glenn Allen, Virginia resource centers.

## 2.4 MANAGERIAL APPROACH TO CONSTRUCTION

OHM's approach to project management is to place the management at a level close to the client. OHM's project manager works directly with the client to achieve the client's satisfaction with the project. Therefore, the project manager will have overall project responsibility to the client from a schedule, cost, and resources aspect. OHM assigns a project superintendent to be responsible for accomplishing the work in the field. The project superintendent reports directly to the project manager. The project superintendent is responsible for the day-to-day activities in the field, and will work closely with the J.R. Simplot management and supervision team.

The project manager and project superintendent will jointly develop the project schedules and budgets and work to achieve these goals over the duration of the project. The schedule and budgets also include the resources required. The required resources will be reviewed with OHM's regional resource manager to schedule the necessary resources for the project. These activities are part of the initial planning activities and act as a baseline for measuring the progress of the project.

OHM will also provide a project accountant (PA) to assist the project superintendent in compiling the daily site costs and assist in procurement activities.

## 2.5 PERSONNEL - DUTIES AND RESPONSIBILITIES

### 2.5.1 OHM Responsibilities

The responsibilities of OHM are:

- Perform the remedial activities defined in the Work Plan and required under delivery order #113.
- Prepare bi-weekly production performance reports.
- Prepare and submit to the Navy monthly status reports containing such information regarding percentage of completion, unresolved delays (encountered or anticipated) that may affect the schedule and a description of efforts made to mitigate those delays or anticipated delays, revise construction schedule, listing of activities scheduled for the next month, and other information relating to the progress of construction as is customary in the industry.
- Initiate, maintain, and supervise all safety precautions and programs in connection with the work.
- If conflict, error, or discrepancy is found in contract documents, report to the Navy Technical Representative (NTR) in writing before proceeding to obtain a written interpretation or clarification from the Navy.
- Notify the NTR representative in writing of any subsurface or latent physical conditions encountered which differ materially from those specified or indicated.
- Implement the Contractor Quality Control Plan (CQCP) and establish chain of command.

- Provide a project superintendent, who will not be replaced without written notice to the Navy; the project superintendent will be OHM's representative/manager.

- If materials or equipment, or specific means, methods, techniques, sequence, or procedure of construction is indicated in or required by the contract documents, furnish or utilize a substitute acceptable to the NTR if needed.

- Procure subcontractor services; submit these services to the Navy for acceptance.

- Maintain at the site two record copies of all as-built drawings, one copy of specifications, addenda, written amendments, change orders, work directive changes, field test records, field orders, and written interpretations and clarifications. Upon completion of the work, deliver these records to the Navy.

- Accurately track project cost, prepare performance reports bi-weekly.

- Coordinate internal resources to meet the project schedule.

- Communicate with the ROICC and RPM so that project information can be disseminated to interested parties.

### 2.5.2 Responsibilities of OHM's Project Management Team

The NWS Yorktown Explosive-Contaminated Soil Removal action will be led by a project-dedicated team who is responsible for the management and completion of the overall project and primary components of design and remediation.

The project manager will have the overall responsibility for project efforts including technical, schedule, and budget aspects. The project manager will be responsible for the day-to-day management and integration of all elements of the project and will be accountable for each activity. Supporting the project manager in the field will be the site superintendent, site safety officer, PA, and other support personnel as needed.

Responsibilities and authority of the project manager and supporting field personnel fundamental to the project are discussed in the following sections.

Since the NWS Yorktown project is relatively small, OHM proposes to use the site superintendent in a dual role as superintendent and QC manager. OHM's site superintendent will coordinate and manage field activities as well as assure field activities will comply with the QC plan and project specifications.

### 2.5.3 Project Manager

The project manager is the person in charge of the overall project and has full authority for coordination and direction of the project. The project manager will communicate directly with the NTR/RPM. Specific responsibilities of the project manager include:

- Interpret and plan overall work effort

- Approve work products, plans, and deliverables

- Overall responsibility for preparation and planning of documents for the work

- Respond to resource requirements by defining resource needs and securing the commitments for staff and equipment
- Monitor subcontractor performance, schedules, budgets, and invoices
- Develop, review, and meet work schedule and budget objectives
- Ensure technical adequacy of field, laboratory, data management, and construction activities
- Prepare for and attend meetings with the Navy, as required
- Document the need for contract modifications, if needed.

To carry out these functions, the project manager will have the authority to:

- Make work assignments for staff and subcontractors
- Allocate additional personnel as needed
- Establish work budgets and schedules with milestones
- Approve subcontractor work and invoices
- Communicate with the site superintendent about day-to-day activities and alert the program manager and/or the project engineer to potential problems
- Maintain OHM quality standards
- Review and approve invoices

### 2.5.4 Project/Site Superintendent

The site superintendent is the OHM contact at the site and is responsible for performing the remediation activities in accordance with the work plan and other project plans and specifications. The site superintenent's responsibilities include, but are not limited to:

- Implementing the day-to-day aspects of the Health and Safety Plan (HASP), and workplan
- Coordinating engineering activities at the site as directed by the project engineer or project manager
- Managing the day-to-day execution of the project at the site including administrative and procurement activities
- Monitoring work progress and schedule, and advise project manager of variances
- Implementing state and federal regulations pertinent to the work
- Assisting in preparation of work progress schedules, project reports, "as-built" drawings, and required compliance submittals

- Compiling the daily logs into a weekly report which will be forwarded to the project manager
- Attending work progress meetings
- Reporting to the project manager changes desired in the contract documents so that required review and approval can be accomplished prior to when the change is made, and reporting for review and approval changes necessitated by unanticipated site conditions
- Procuring, with approval of the project manager, subcontractor services, vendor services, and materials
- Ensuring that remedial rework is subjected to the same quality requirements as the original work.

The superintendent, in his role as NWS Yorktown site QC representative, will be responsible for coordinating inspection and surveillance activities. The superintendent will be supported in the field by a sample technician and geotechnician, as needed. The technicians will assist in or conduct inspections and/or surveillances to monitor completion and corrections of work performed on site. The superintendent and the technicians will monitor the full site activities on a periodic basis. The results of inspections and surveillances will be documented in a report describing the events reviewed that day. The superintendent will also be responsible for:

- Day-to-day coordination of technical activities
- Reviewing results of on-site verification testing and inspection reports.
- Implementing appropriate provisions of this plan.
- Serving as the collection point for remediation-related nonconformance.
- Perform, or cause to be performed, daily inspections and tests of the scope and character necessary to achieve the quality of construction outlined in the plans and specifications for work under the contract performed on or off site.
- Maintain the latest applicable drawings and specifications with amendments and/or approved modifications at the job site and assure that they are used for shop drawings, fabrication, construction, inspections, and testing.
- Maintain marked-up drawings at the site depicting as-built conditions. The drawings will be available for review by the government at all times.
- Hold and preside over bi-weekly quality review meetings of the site work being performed, and review proposed work procedures and type of work scheduled.
- Maintain a contractor-generated submittal register, ENG Form 4288, for the duration of the contract. A review of the register will be performed at least every 14 days in conjunction with the scheduled dates on the register and in relation to the actual work status. Appropriate actions will be undertaken should slippages or other changes so necessitate.
- Review shop drawings and/or other submittals for compliance with the contract requirements prior to their transmission to the government.

- Establish and maintain a Rework Item List of work that does not conform to specifications. Track and monitor the items on the list to assure the rework inspection and testing activities and frequencies are in accordance with the contract requirements.

- Attend and assist the government at the prefinal inspection and the final acceptance inspection.

- Confirm the quality and quantity of materials delivered to the site as referenced by the project specifications and/or design drawings.

### 2.5.5 Site Safety Officer

The site safety officer (SSO) is responsible for implementing the HASP which satisfies federal, state, and local regulations and is consistent with site conditions. The site safety officer may take actions independent of the project group to stop the project, if required, for compliance with the HASP.

The site superintendent is responsible for the day-to-day implementation of the HASP during site activities. The site safety officer will oversee this day-to-day implementation, including the following responsibilities:

- Directing the entrance and exit medical physical requirements, if required

- Approval of personnel protective equipment and safety procedures specified in the HASP

- Overseeing the maintenance and use of field monitoring equipment necessary to define on-site hazards associated with remediation

- Designating appropriate personnel protection level; determining protection level upgrades and downgrades as site conditions permit

- Providing necessary guidance to the project staff so they can safely perform their functions in accordance with federal and state regulations

### 2.5.6 Project Accountant

The responsibilities of the project accountant (PA) are:

- Accrue daily costs into PTS

- Assist the project manager in preparation of schedules, budgets, and invoices

- Maintain tracking systems to track costs and budget variances

- Provide weekly progress reports on budget and schedule status to the project manager

- Prepare daily report deliverables

- Audit weekly postings of charges to work budgets

- Assist the project manager in communicating work procedures and goals to OHM's staff

- Assist site superintendent in procurement activities

- Finalize costs for invoices to the government
- Perform on site administrative duties.

### 2.5.7 Sample Technician

The responsibilities of the sample technician are:

- Performing all sampling activities in accordance with the approved protocols. Navy quality assurance (QA) procedures are the approved protocols for this project.

# 3.0 DESCRIPTION OF ACTIVITIES

## 3.1 SITE PREPARATION

### 3.1.1 Site Preparation

Site preparation consists of those activities required by the specifications and OHM policy to establish control over work areas. Included in this task are infrastructure features such as roads and entrances, and safety features such as decontamination facilities.

During mobilization activities OHM will initiate site preparation tasks. These tasks include:

- Installation of erosion and sedimentation controls, as previously mentioned, at both Site 7 and Site 22.
- Installation of the temporary decontamination pads at both sites
- Placement of a temporary poly holding tank for storage of decontamination water at the first site to be excavated
- Connect power to trailer, install backflow preventor, tie-in communications lines, install porta-johns, install weather station
- Delineate areas for safety zone fencing and personnel decontamination facilities
- Delineate limit of clearing and grubbing at Site 7, identify vegetation that needs to be protected, layout construction entrances and proposed locations of equipment decontamination pad and perform utility verification survey

### 3.1.2 Work Zones and Temporary Fence

Site 7 will serve as an independent exclusion zone. Once excavation is complete and the Navy has approved the excavation limits, OHM will backfill the excavation with imported or on-site soil and secure the excavation with temporary excavation fencing. The fencing will remain in place until the area is backfilled, the loam/topsoil is placed, hydroseeding has occurred, and the erosion control matting has been stapled in place.

### 3.1.3 Clearing and Grubbing

OHM anticipates that Site 7 is the excavation area that will require the removal of bushes, roots and trees. OHM will only clear trees that are interferring with the limits of excavation. The cleared grubbing debris will be chipped by OHM.

### 3.1.4 Protection of Existing Features

In general, OHM will limit the extent of clearing operations to that area required for access to Site 7, and all reasonable attempts will be made to keep the construction area size to a minimum. Similarly, the size and number of staging and support zone at Site 7 will be kept to a minimum.

All reasonable attempts will be made to minimize landscape defacement. This will include the trimming of trees and brush instead of removal, wherever possible. Operation of equipment will be limited to the confines of the construction areas to minimize the potential for residual damage to landscape features.

OHM will take all reasonable measures to assure no residual damage. In the event that damage is done to the landscape, the affected area or feature will be restored as soon as the restoration is deemed practical.

Vegetation removed as part of the planned clearing operations will not be replaced. Only the approved seed mixture will be placed to restore these areas.

### 3.1.5 Dust Control

OHM understands the importance of controlling dust emissions and it is anticipated that a standard water truck would be adequate for this project, due to the limited traffic that would be required to access each site during excavation and backfilling. OHM proposes to have a water truck with a sprinkler attachment on-site to manage dusty conditions. OHM will require the navy to identify an acceptable water source for use in the trucks. Determination of the need for dust control will be the responsibility of the OHM on-site superintendent.

### 3.1.6 Security

During site preparation/mobilization OHM will comply with site security requirements. OHM will obtain security badges for all employees on-site, and each employee will register with the security department by providing their names and social security numbers. OHM personnel will be restricted from entering areas of the base other than our active work sites. When applicable, OHM will secure site permits required for welding, digging, and burning. OHM does not expect to hire a security service for work at Yorktown NWS; however, if site conditions warrant after hours security, OHM will employ such services.

### 3.1.7 Erosion and Sedimentation Control

#### 3.1.7.1 Silt Fence

As provided for in the specifications OHM will elect to install a preassembled silt fence that meets the minimum design properties as outlined in the specifications. OHM will provide shop drawings for the silt fence proposed for use, and upon approval from the Navy, the silt fence will be installed in accordance with the manufacturers recommendations. Silt fence will be installed at Site 7 and Site 22.

#### 3.1.7.2 Straw Bales

Straw bales will be installed as necessary at Site 7 and Site 22.

#### 3.1.7.3 Temporary Seeding

OHM does not anticipate that temporary seeding will be required. Upon completion of backfill OHM expects to perform final site restoration with the permanent specified seed mix.

## 3.2 EXCAVATION

### 3.2.1 Excavation Procedures

OHM will use an excavator to remove contaminated soil from Site 7. OHM expects that the excavation, loading, and transportation will take three days. OHM will schedule the appropriate number of trucks and/or roll-off containers for each day's excavation. OHM will directly load-out the soils into the transportation trucks/roll-offs. For purposes of determining the amount of soil removed from Site 7, OHM will measure the water level volume of the trucks used to transport the soil from Site 7 to Site 22. From this volume calculation, an assumed density of the soil will be 1½ tons per cubic yard. These quantities will be tabulated on a per load basis and supplied to J.R. Simplot for their use in determining the proper mix of constituents for the bioremediation process. When excavation of contaminated soils is complete, the Navy will indicate that the limit has been achieved, and OHM will commence backfilling operations.

At Site 22, the biocell will be constructed after first surveying the area and selecting the best possible location to facilitate ease of construction and site logistics. The biocell will be staked-out (approximately 86 feet by 150 feet) then excavated utilizing a CAT 225 excavator or equivalent. The excavated material will be stockpiled adjacent to the excavation. A detail of the biocell layout is shown in Figure 1.

Once the excavation has been completed to the appropriate depth, a six inch sand layer will be placed on the bottom to protect the liners from protrusions. Next, a 60 mil HDPE liner will be placed over the excavation. On top of this liner will be placed a six inch layer of sand, then a geonet. Finally, an 80 mil HDPE liner will be placed. An anchor trench for the liners will be excavated along the sides of the biocell. The liners will be placed in the anchor trench then filled with 3000 psi concrete. This anchor trench will act as the footing for the rail mounted gantry system supplied by Simplot.

### 3.2.2 Equipment and Personnel Decontamination

OHM will decontaminate equipment and personnel in accordance with our standard decontamination procedures, as delineated in Section 6.0 of the OHM Health and Safety Plan, which can be found in Appendix C to this submittal.

### 3.2.3 Traffic Control

During excavation and backfilling operations OHM will manage traffic to assure that truckers know the approved traffic patterns and to assure that truckers know which site they are required to haul from or to each day. OHM intends to designate one laborer as traffic coordinator. This individual will perform all necessary duties to assure that the flow of traffic runs smoothly. This person will assist with communication between the heavy equipment operators, the truck drivers and other laborers on the ground. Additional labor will be provided if necessary.

## 3.3 EXCAVATION BACKFILL

OHM will commence backfilling operations when the Navy notifies OHM. OHM intends to use the following equipment for backfilling activities:

- Excavator
- Bulldozer

Backfill will commence using the excavator and bulldozer. The backfill will be compacted, as specified, by the bulldozer.

### 3.3.1 Backfill Testing

OHM will perform laboratory testing on any backfill materials as required in the specifications. OHM will ensure that all imported materials are certified clean through laboratory analytical testing. All geotechnical and chemical testing results will be submitted to the Navy.

### 3.3.2 Removal of Erosion and Sedimentation Features

OHM will evaluate if removal of erosion and sedimentation features is recommended during site restoration activities. OHM may recommend leaving the erosion and sedimentation structures in place until a suitable stand of grass is established. If the erosion and sedimentation features are left in place at the time of demobilization, OHM will return to the site at a later date to remove the erosion and sedimentation features.

## 3.4 DEMOBILIZATION

Demobilization will include the following activities.

### 3.4.1 Decontaminate Site Equipment

All site equipment that comes in contact with contaminated soil will be decontaminated using high pressure washing before leaving the site. The resulting decontamination water will be disposed in the biocell at Site 22. Refer to Figures 2, 3, and 4 for site layout and decontamination area details.

### 3.4.2 Site Cleanup

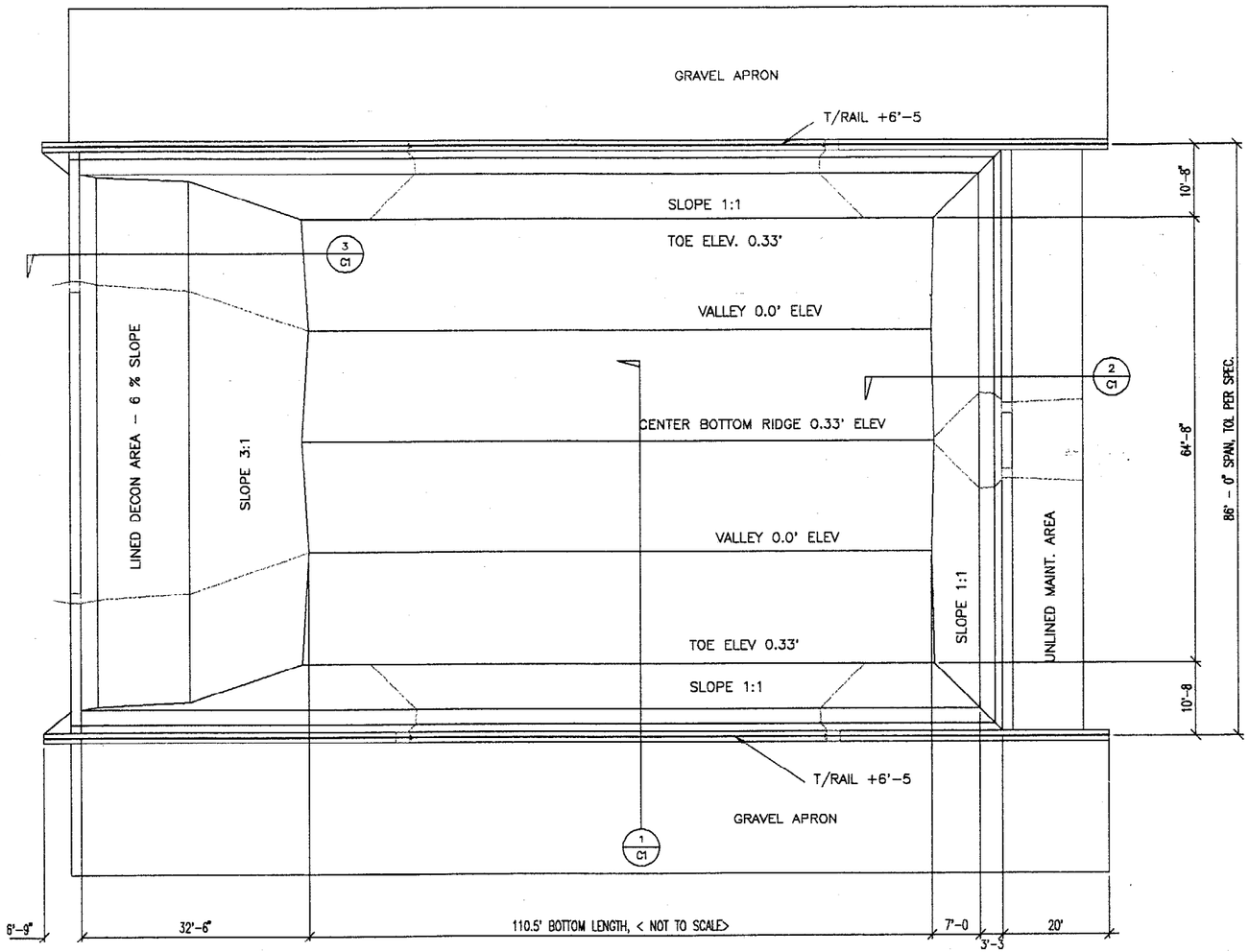
Temporary utilities will be disconnected when they are no longer needed. The site will be cleaned up by removing traces of temporary construction facilities such as work areas, structures, stockpiles of excess or waste materials, and other signs of construction. The site supervisor will verify the site is clean and restored to a level acceptable to the ROICC before demobilizing the remaining site resources.

### 3.4.3 Demobilize Resources

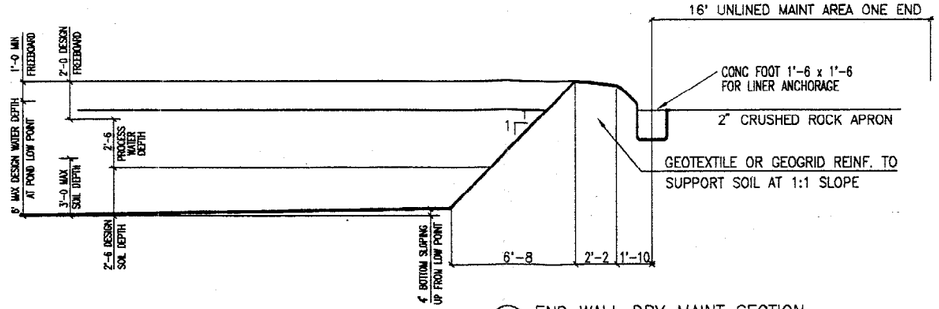
All equipment will be visually inspected for proper decontamination prior to leaving the site. Additional material not utilized will be removed from the site.

# *FIGURES*

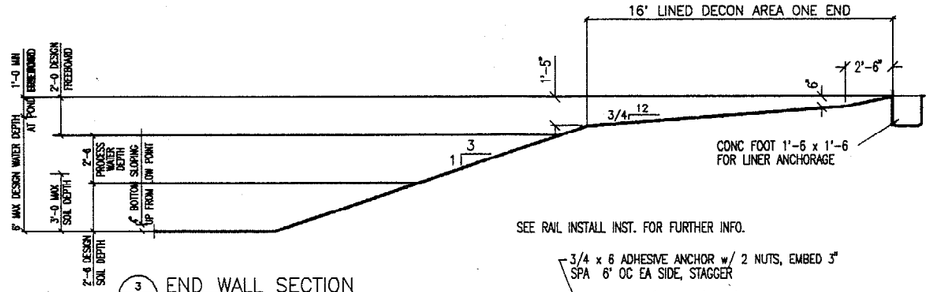
X-REF TOPO-1 | OHM CORPORATION PITTSBURGH, PA | DRAWING NUMBER 3757-D1




POND PLAN
SCALE: 3/32" = 1'-0

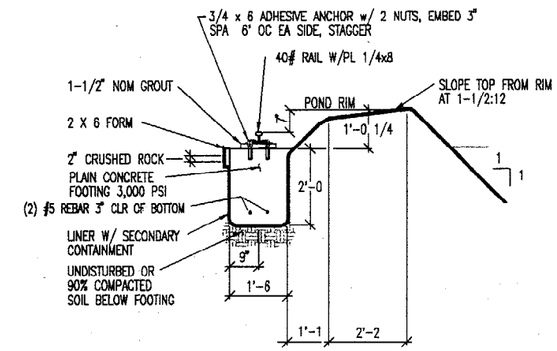



2 C1 END WALL DRY MAINT SECTION
SCALE: 1/4" = 1'-0

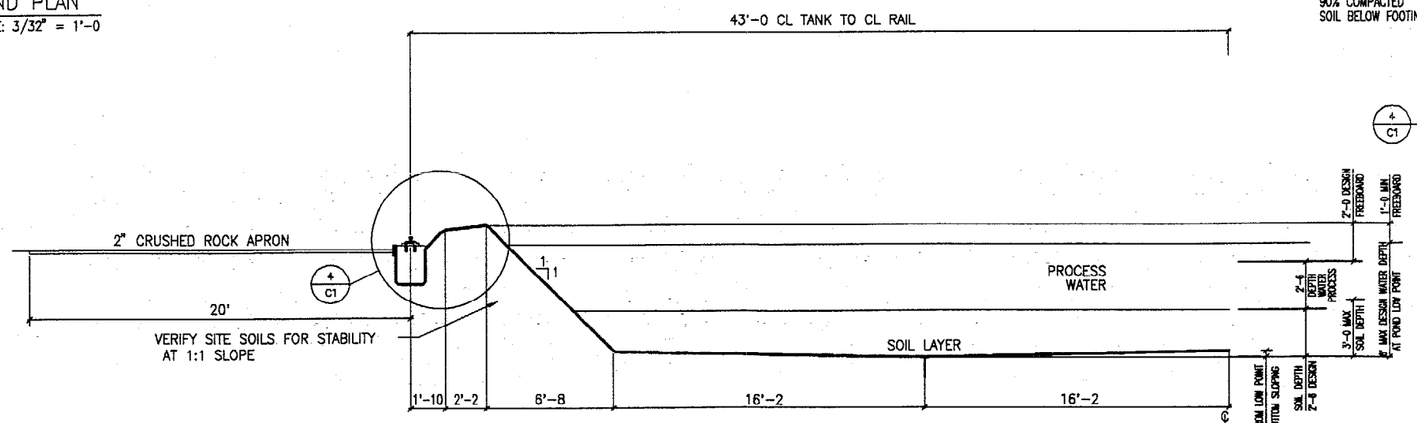



3 C1 END WALL SECTION
SCALE: 1/4" = 1'-0

SEE RAIL INSTALL INST. FOR FURTHER INFO.




4 C1 DETAIL @ CONC. FOOTING
SCALE: 1/2" = 1'-0




1 C1 POND HALF CROSS SECTION
SCALE: 1/4" = 1'-0

NOTES:

POND DESIGN IS INDICATED FOR GEOMETRY AND MIX BRIDGE FOUNDATIONS AND IS GENERIC. SITE SPECIFIC DRAWINGS BASED ON ACTUAL CONDITIONS ARE REQUIRED. RIM ELEVATION INDICATED IS A MINIMUM, PROVIDE ADDITIONAL RIM HEIGHT TO ACCOMODATE CONST. TOLERANCES.

DESIGN OF THE LINER, APRONS, CONTAINMENTS ARE TO COMPLY WITH ALL GOVERNING REGULATIONS. SITE SPECIFIC DESIGN SHALL INCORPORATE THESE DETAILS TO FULLY CONFORM TO THESE REGULATIONS AND BE APPROVED BY THE GOVERNING AGENCIES.

FREEBOARD AT DESIGN DEPTHS IS 2'-0", THIS ALLOWS 21 INCHES OF PRECIPITATION BEFORE OVERFLOW. ESTABLISH SITE PRECIPITATION RATES AT 50 YEAR RECURRANCE INTERVAL AND THE EXPECTED EVAPORATION RATES TO DETERMINE SITE SPECIFIC DESIGN AND MINIMUM FREEBOARD DIMENSIONS. ESTABLISH IN SITE PLAN METHODS TO CONTROL WATER LEVEL.

PLOT SCALE: 1 = 48

REVISIONS

| NUMBER | DESCRIPTION | DATE | APPROVED BY |
|---|---|---|---|

OHM Remediation Services Corp.
OHM PROJECT NO. 18757

| DRAWN BY | CHECKED BY | APPROVED BY | DATE |
|---|---|---|---|
| C. Agabiti | M. Kravecz | M. Kravecz | 8/28/98 |

FOR BID FOR CONTRACTOR INITIAL ____ DATE ____

NAVAL FACILITIES ENGINEERING COMMAND
DEPARTMENT OF THE NAVY
ATLANTIC DIVISION
NORFOLK, VIRGINIA
NAVAL STATION
NAVAL WEAPONS STATION
YORKTOWN, VIRGINIA

FIGURE 1
BIOCELL LAYOUT - SITE 22

FIELD SCALE TREATABILITY STUDY

SEAL AREA

| | |
|---|---|
| CODE ID. NO. 80091 | SIZE: D |
| SCALE: | AS SHOWN |
| EFD NO. | |
| STA. PROJECT NO. | |
| SPEC NO. | |
| CONSTR. CONTRACT NO. | |
| NAVFAC DRAWING NO. | |
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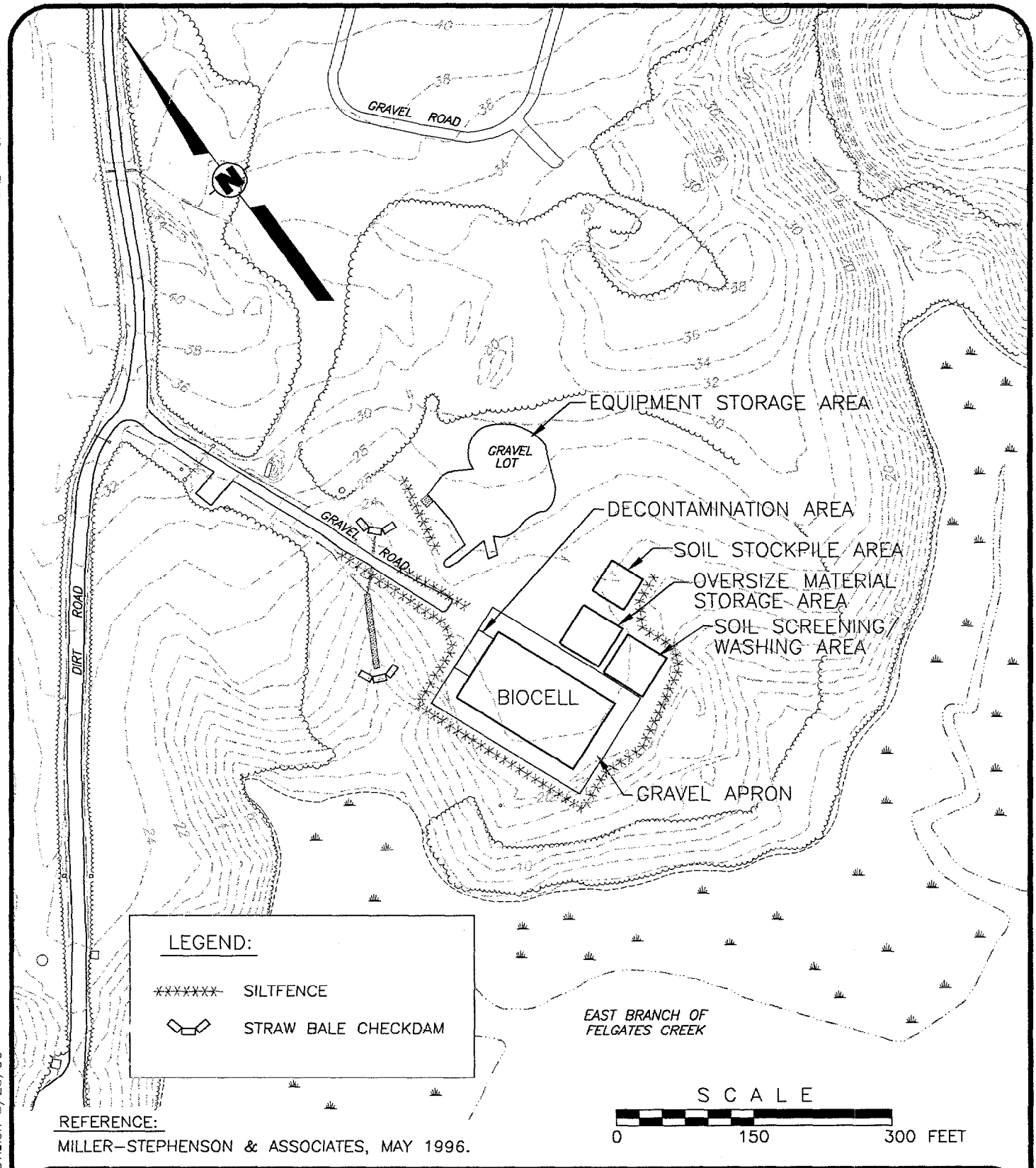


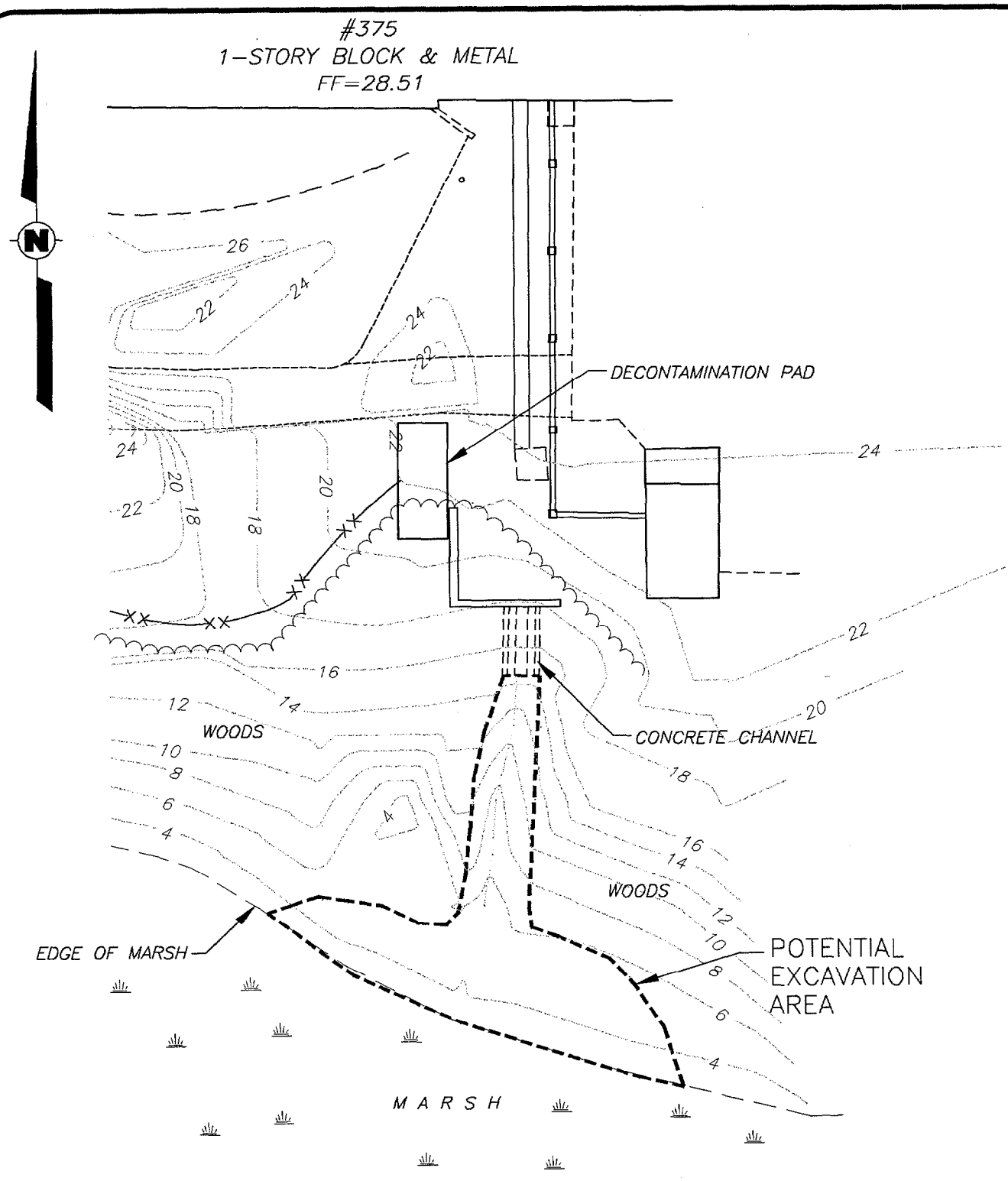

REFERENCE:
MILLER–STEPHENSON & ASSOCIATES, MAY 1996.

**OHM Remediation Services Corp.**
OHM Project No. 18757

| Drawn By: | Checked By: | Approved By: |
|---|---|---|
| A. Smith | J. Faison | M. Kravecz |
| Date: | Scale: | Drawing No. |
| 8/5/96 | N.T.S. | 18757–A3 |

FIGURE 2
SITE 22 LAYOUT – BIOTREATMENT CELL
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA
PREPARED FOR
DEPARTMENT OF THE NAVY – ATLANTIC DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORFOLK, VIRGINIA

CAD File: 18757-A3
Plot Scale: 1 = 150 revision 8/29/96




REFERENCE:

MILLER-STEPHENSON & ASSOC., JULY 1996

SCALE

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OHM Remediation Services Corp.

OHM Project No. 18757

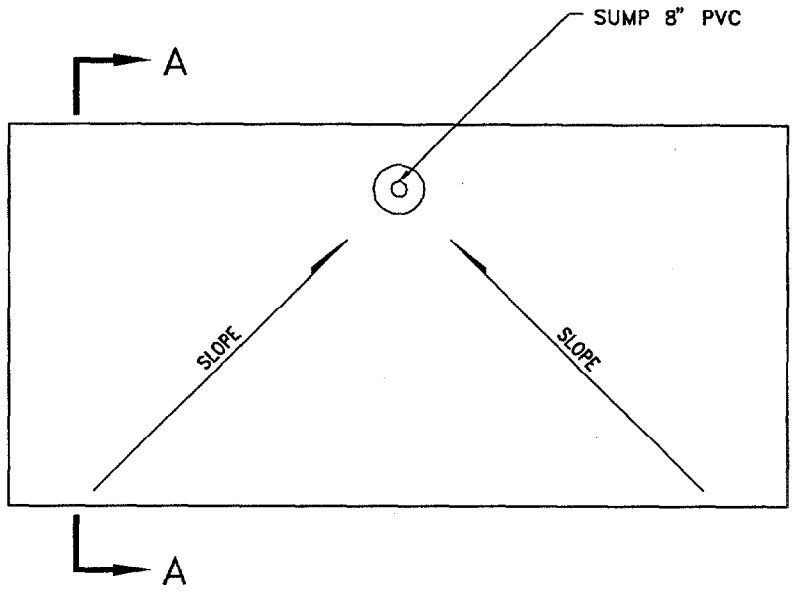
| Drawn By: | Checked By: | Approved By: |
|---|---|---|
| A. Smith | J. Faison | M. Kravecz |
| Date: | Scale: | Drawing No. |
| 8/5/96 | N.T.S. | 18757-A2 |

FIGURE 3
LAYOUT - SITE 7
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA
PREPARED FOR
DEPARTMENT OF THE NAVY - ATLANTIC DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORFOLK, VIRGINIA

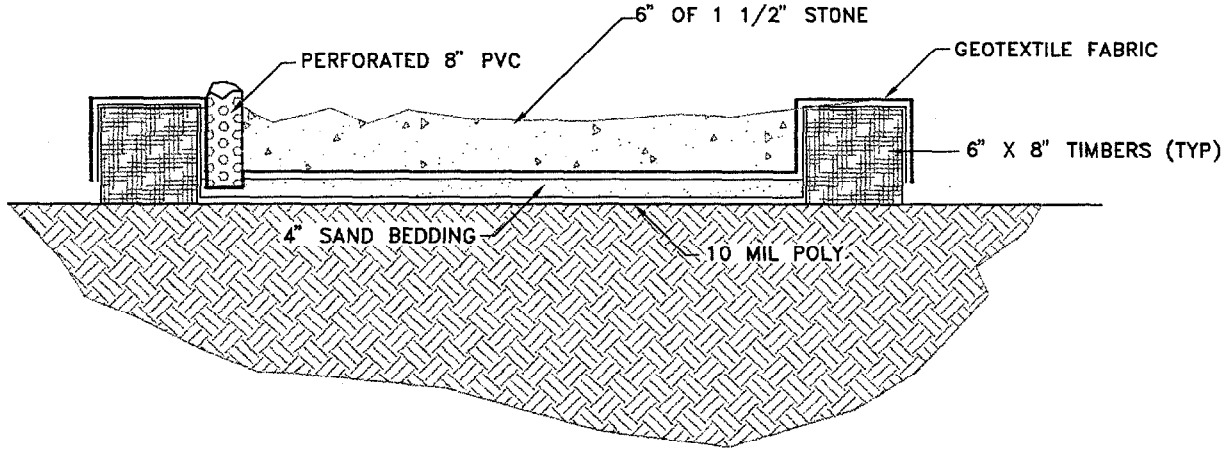
CAD File: 18757-A2

Plot Scale: 1 = 30 revision 8/29/96

CAD File: 18757-A6




## PLAN VIEW




## SECTION A-A

NOT TO SCALE

SCALE

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OHM Remediation Services Corp.

OHM Project No. 18757

| Drawn By: | Checked By: | Approved By: |
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| C. Agabiti | M. Kravecz | M. Kravecz |
| Date: | Scale: | Drawing No. |
| 8/29/96 | AS SHOWN | 18757-A6 |

FIGURE 4
TYPICAL DECON PAD DETAIL
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA
PREPARED FOR
DEPARTMENT OF THE NAVY – ATLANTIC DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORFOLK, VIRGINIA

Plot Scale: 1 = 10 revision 1

# *APPENDIX A*
# *QUALITY CONTROL PLAN*

# QUALITY CONTROL PLAN
# FOR
# FIELD SCALE TREATABILITY STUDY
# NAVAL WEAPONS STATION,
# YORKTOWN, VIRGINIA

Prepared for:

DEPARTMENT OF THE NAVY
Contract No. N62470-93-D-3032
Delivery Order 0113

Prepared by:

OHM Remediation Services Corp.
Trenton, New Jersey

Michael I. Gilman
Program QC Manager

Reviewed by:

Mark Kravecz
Project Manager

John Franz
Program Manager

August 5, 1996
OHM Project 18757QC

OHM Remediation Services Corp.
A Subsidiary of OHM Corporation

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**LIST OF FIGURES**

# *1.0 STATEMENT OF QC PROGRAM*

OHM Remediation Services Corp. (OHM), a subsidiary of OHM Corporation, will provide and maintain an effective Contractor Quality Control (CQC) Program as required by contract clauses. This program will be performed in conjunction with the Program Quality Control Plan (OHM, 1994) as applicable and in accordance with the requirements of Contract No. N62470-93-D-3032, Atlantic Division, Naval Facilities Engineering Command, dated August 1993. OHM will perform the inspections and tests required to ensure that materials, workmanship, and construction conform to the drawings, specifications, and contract requirements. OHM will perform the test or inspection specified, unless the required inspection and/or test is specifically designated to be performed by the Government.

# 2.0 *PROGRAM ORGANIZATION AND PERSONNEL RESPONSIBILITIES*

OHM will implement the CQC Program by establishing a QC organization which works directly with the Navy's on-site representative and reports to the OHM Program QC Manager. The QC organization will consist of not less than one full-time QC person who will be at the site while work is in progress to verify compliance with the contract requirements. The QC organization will be supplemented by additional QC personnel as may be necessary. OHM recognizes that the Navy Technical Representative (NTR) reserves the right to replace a member of the QC staff who, in the opinion of the NTR, is not accomplishing their assigned duties.

The CQC Program includes an inspection schedule, which will be available for review prior to the start of construction and throughout the life of the project. The inspection and testing processes will monitor the overall quality of work, and project controls will be instituted to assure correction of deficiencies identified during the inspections and testing. Project scheduling will be instituted to assure proper sequence and performance of work activities.

The NTR will be notified in writing prior to proposed changes to the CQC Program, and the proposed changes will be subject to the NTR's approval prior to implementation.

OHM's QC organization chart for Delivery Order 0113 is included as Figure 1. Professional profiles of OHM's delivery order specific project team and QC team are provided in the attachment to this plan. Professional profiles of OHM's Program Management team are provided in the Program QC Plan. The responsibilities of each person identified in the QC organization are presented below.

## 2.1 PROGRAM MANAGER, JOHN FRANZ, P.E.

The program manager has ultimate responsibility for QC of project deliverables. Specific responsibilities includes:

- Reviewing all deliverables prior to submittal to Atlantic Division, Naval Facilities Engineering Command
- Communicating with the OHM Project Manager to ensure project schedule and scope compliance
- Communicating with Contracting Officer (CO), Contracting Officer's Technical Representative (COTR), and/or NTR on a regular basis to review project progress and contract compliance
- Reviewing program QC procedures
- Providing cost accounting updates to verify project is within budget.

## 2.2 PROJECT MANAGER, MARK KRAVECZ

The Project Manager is responsible for:

- Providing deliverables which are both responsive and on schedule
- Reviewing all project activities including, but not limited to, sampling, remediation, decontamination, documentation, chain-of-custody procedures, site rules and compliance, and compliance with the OHM site-specific health and safety plan and the work plan
- Monitoring project progress to ensure schedule and budget maintenance
- Ensure CQC program is being performed.

## 2.3 SITE SUPERVISOR, WARE WARBURTON

The site supervisor is responsible for day-to-day on-site activities. He communicates with the project manager to update him on project progress and QC activities.

## 2.4 PROGRAM QC MANAGER, MICHAEL I. GILMAN

The program QC Manager is responsible for delivery order quality and, for this delivery order, will provide support to the project Manager on an as-needed basis. If an independent site audit were to take place during site activities, the program QC Manager would perform the audit. The program QC Manager will oversee work performed by the site QC Manager. The QC Manager will also monitor the correction of any nonconforming work. He will be responsible for reviewing the laboratory QC program to ensure its conformance with the contract program requirements.

## 2.5 SITE QUALITY CONTROL MANAGER, WARE WARBURTON

The responsibilities of the site QC Manager will include:

- Perform, or cause to be performed, daily inspections and tests of the scope and characters necessary to achieve the quality of construction outlined in the plans and specifications for work under the contract.
- Maintain the latest applicable drawings and specifications with amendments and/or approved modifications at the job site and assure that they are used for shop drawings, fabrication, construction, inspections, and testing.
- Maintain marked-up drawings at the site depicting as-built conditions. The drawings will be available for review by the NTR at all times.
- Maintain the delivery order submittal register (see Section 6.4 of this plan) for the duration of the contract. A review of the register will be performed at least every 14 days in conjunction with the scheduled dates on the register and in relation to the actual work status. Appropriate actions will be undertaken should slippages or other changes so necessitate.
- Review shop drawings and/or other submittals for compliance with the contract requirements prior to their transmission to the Navy.

- Authorization to temporarily shut down a portion of work if work practices or procedures are determined to be incorrect or out of compliance with the specifications.
- Authorization to stop a work task or series of tasks after consultation with the site supervisor and NTR in the event that severe weather conditions interfere with quality of work.
- Responsible for testing construction and backfill materials for compliance with specifications and authorized to reject materials to be used if they are not in compliance.
- Establish and maintain a Rework Items List program and a tracking and/or suspense system to monitor and assure inspection and testing activities and frequencies are in accordance with the contract requirements. This list will be submitted on a monthly basis.
- Attend and assist the Government at the prefinal inspection and final acceptance inspection.
- Assist in preparing Contractor Production Report.
- Prepare and submit daily Contractor QC Report.
- Prepare, maintain, and continually update the Construction Testing Plan and Log for the field activities.
- Conduct and document QC meetings on site.

# 3.0 METHODS OF INSPECTION

A three-phase control system will be implemented for each major work task and will include preparatory, progress, and follow up inspections. The QC Manager will assure that no work proceeds until the appropriate inspections have been performed. In addition to the three phase system, the Site QC Manager will also conduct receiving inspections for all materials arriving on site being incorporated into the project. An inspection schedule listing the expected major phases of work for which the inspections will be conducted is presented in Attachment B. In addition to, and independent of, the site QC Manager, the site safety officer (SSO) and site supervisor will implement this same control system as part of their normal duties/responsibilities. The inspection phases are discussed in the following paragraphs.

A preparatory inspection will be performed by the site QC Manager prior to beginning physical work. This will consist of a meeting attended by site QC Manager, site supervisor, and site foreman in charge of the relevant task. This meeting shall include a review of contract requirements, including relevant plans and specifications; a check to assure that all required submittals have been submitted and approved; a discussion of required testing and what constitutes acceptable work; a physical examination of material and equipment necessary to perform task; and a discussion of construction methods. The purpose of this phase of inspection is to establish exactly what is required in order to comply with the contract documents, making sure that the people in charge of performing the task understand these requirements, and to try and foresee and resolve any potential problems. The NTR will be notified a minimum of 24-hours prior to the beginning of the preparatory inspection.

A progress inspection will be performed by the site QC Manager as soon as a representative segment of the particular item of work has been accomplished. The progress inspection will include an examination of the quality of workmanship and a review of control testing results for compliance with contract requirements, use of defective or damaged materials, omissions, and dimensional requirements. The purpose of this phase of inspection is to ensure that the requirements outlined in the preparatory phase are being met. Should any additional requirements be necessary to ensure contract compliance, they will be identified in the progress inspection report. Progress inspections will be performed periodically throughout a task to ensure that work continues to meet the requirements of the contract documents.

Follow-up inspections will be performed by the site QC Manager after a task has been completed. The purpose of this phase of inspection is to ensure that the completed task has met all of the contract requirements, including any required testing. Should any rework items be identified at this stage, an additional follow-up inspection will be required. A satisfactory follow-up inspection indicates successful (contract compliance) completion of the task. The NTR will be notified a minimum of 24-hours prior to the beginning of the follow-up inspection.

Inspections will be documented and tracked by the site QC Manager, with copies of the inspection reports attached to the CQC Daily Report.

Receiving inspections will be conducted whenever material to be incorporated into the project arrives on site. These inspections shall consist of verifying that materials received match the purchase order and that the materials meet specifications. The materials received each day will be noted on the site supervisor's daily report which is attached to the QC daily report.

In addition to the inspections outlined above, special inspections or testing may be conducted in the event of an approved change or modification to work plans or field operations. The site QC Manager will

coordinate scheduling of special inspections with the Contracting Officer at the time when a change or modification in work operations has been approved.

It is OHM's responsibility to identify and correct deficiencies in the work. To ensure that defective work is corrected and not built upon, a Rework Items System will be implemented. Rework items identified in the work during any of the inspections or testing programs by a party to this contract will be corrected as soon as practicable and recorded by completing a Rework Items List. The list will be issued to the site supervisor and a copy attached to the inspection report. The site QC Manager will be responsible for documenting and tracking rework items, with a description of the deficiency, the action taken and date completed. The list will be updated accordingly. The form to be used for tracking is included in Attachment C.

In addition to site QC Manager directed inspections, standard inspections will be performed during the course of remediation to verify the quality of the final construction work. There will be visual inspections performed by the site supervisor, a qualified general foreman, or other appropriate personnel. These inspections are supplemental to the site QC inspections and are intended to enhance the QC inspections by identifying problem areas that may require more stringent QC inspection. In the event of a discrepancy between one of these visual inspections and the field verification test performed as per this document, the field verification test result will take precedence.

# *4.0 SAMPLING PROCEDURES*

As part of this specific scope of work, OHM will not perform any field sampling. Should the need for sampling arise, a site specific sampling plan will be generated for the project.

# 5.0 FIELD VERIFICATION TESTING

The following requirements will be used by the OHM site QC Manager during the performance of his/her duties to verify compliance with the contract requirements. Additions or modifications to these requirements may be necessary to address changing circumstances. The responsibilities of the site QC Manager are fully described in Section 2.0 of this QC Plan.

## 5.1 GENERAL REQUIREMENTS

Verification of field testing requirements will be performed in accordance with this plan. OHM will witness/verify, on a sampling basis, the tests performed by the contractors/suppliers as required by the project installation specifications. Additional testing that may be required by the QC Manager of the project, such as specific field verification testing, will be performed in accordance with this plan. OHM will utilize testing agency (agencies), to be named later, for various types of field testing requirements. The testing laboratories used in the testing shall have a QA program acceptable for this project. The equipment/measurements used in testing shall be calibrated on regular intervals and all measurements shall be traceable to national bureau of standards. In the event that any single test fails to meet the specification requirements, a second test will be performed. Should the second test fail, the appropriate corrective action will be taken in the field. If the second test meets the specification requirements, then the corresponding verification test will be conducted. The results of that test will then be used to determine the acceptance or rejection of the construction task, or equipment/material being monitored.

## 5.2 FIELD TESTING

The site QC Manager will review the QC data to verify that testing requirements are being met, or to determine when defective material or work may require removal and/or reconstruction, and when additional testing may be required to confirm the quality of the material or work. The results of field tests, field inspections, receiving inspections, and surveys will be reviewed by the site QC Manager. The review will be made on a daily basis to prevent the construction of new work over defective material or work which is later found to be defective.

# 6.0 INSPECTION AND TESTING DOCUMENTATION

## 6.1 DAILY RECORDS

Daily records of inspections and tests performed for each shift or subcontractor operation will be signed by the site QC Manager and the original and one copy provided to the NTR no later than the next working day. Samples of reports and forms to be utilized are included in the Program QC Plan.

The site QC Manager will prepare a daily CQC report/production report which will include, as a minimum, the following:

- Project identification
- Data on weather and any delays attributable to such weather
- Number of personnel on site (OHM and subcontractors)
- A listing of construction equipment and indication of equipment usage on the report day
- Factual evidence that continuous QC inspections and tests have been performed. This includes, but is not limited to, the following data:
  - Type and number of inspections or tests performed
  - Results of inspections or tests including computations
  - Evaluation of test results--accept or reject work
  - Nature of defects, if present
  - Causes for rejection
  - Safety inspections/violations
  - Proposed remedial action
  - Corrective actions taken
- The records will cover both conforming and non-conforming work
- A statement that supplies and materials incorporated into the work are in full compliance with the requirements of the contract

## 6.2 PERFORMANCE DOCUMENTATION

Construction inspection personnel (site supervisor, foreman, and site QC Manager) will keep a daily log of project activities. Whenever possible, information will be recorded on a standardized form or in a bound field logbook. Documentation will include a daily log of construction activities; the appropriate field test, laboratory test, and survey data forms; photographs; and field collection and sampling custody forms. Copies of the daily logs will be sent to the site supervisor on a daily basis. After review of the logs, they will be routed to other members of the project team as needed.

As part of the remediation control activities, a photographic record is to be prepared. Photographs will be in color. As examples, photographs could be taken of field testing, sampling locations, remediation processes, and final constructed features.

Photographs are to be identified with the project number, date taken, and a brief description. This may be done individually on the back of the photographs or in an album in which the photographs are mounted. Album photographs must be provided with individual descriptions and dates taken.

Appropriate remediation control test, survey, and material installation data forms will also be prepared. All requested information will be addressed, including the location of the activity. If not applicable, requested information will be designated as such. Results of field and laboratory testing will be sent to the NTR, the project manager and site supervisor as soon as they become available.

Field construction verification records will be collected and maintained by the site supervisor until they are submitted to the project central file.

## 6.3 AS-BUILT DOCUMENTATION

All appropriate documentation will be retained in the project records system to provide documentation of how the remedial action was actually built. Final as-built drawings and specifications will be prepared utilizing this information and retained as a permanent record of the final location, dimensions, and orientation of the construction.

At contract closeout, record documents will be delivered to the NTR. A transmittal letter in duplicate accompanying the submittal will contain:

- Date
- Contract name and number
- Contractor's name, address, and telephone number
- Number and title of each record document
- Signature of contractor or his authorized representative.

# 7.0 MEETINGS/COORDINATION

## 7.1 COORDINATION AND MUTUAL UNDERSTANDING MEETING

After submission of the QC plan addendum and prior to the start of construction, OHM's project manager, program QC Manager, and site QC Manager will meet with the COTR and the NTR to discuss the QC program required by this delivery order. The purpose of this meeting is to develop a mutual understanding of the QC details, including forms to be used; administration of on-site and off-site work; and coordination of the OHM management, production, and the QC Manager's duties with the NTR. Minutes of the meeting will be prepared by the QC Manager and signed by both OHM and the COTR. This meeting may be combined with the pre-construction meeting.

## 7.2. QC MEETINGS

After the start of construction, the OHM site QC Manager will conduct QC meetings once every week or as required by the COTR/delivery order at the work site, or where specified, with the site supervisor, the foreman responsible for the upcoming work, and the NTR. The OHM site QC Manager will prepare the minutes of the meeting and provide a copy to the COTR within two working days after the meeting. The site QC Manager will notify the NTR at least 48 hours in advance of each meeting. As a minimum, the following will be accomplished at each meeting:

- Review the minutes of the previous meeting.
- Review the schedule and the status of work:
  - Work or testing accomplished since last meeting
  - Rework items identified since last meeting
  - Rework items completed since last meeting
- Review status of submittals:
  - Submittals reviewed and approved since last meeting
  - Submittals required in the near future
- Review work to be accomplished in the next week and documentation required. Schedule the three phases of control and testing:
  - Establish completion dates for rework items
  - Preparatory phases required
  - Initial phases required
  - Follow-up phases required
  - Testing required
  - Status of off-site work or testing
  - Documentation required.
- Resolve any QC concerns
- Address items that may require revising the QC plan (e.g., changes in procedures)
  - Changes in procedures.

# *ATTACHMENT A*
# *PROFESSIONAL PROFILES*

# *PROJECT MANAGER'S RESUME*

# MARK J. KRAVECZ

Mr. Kravecz joined OHM in 1990 having over 8 years experience in managing major construction projects. Since joining OHM Mr. Kravecz has successfully managed major environmental and construction projects, including multi-million dollar soil excavation projects. He has extensive experience in cost control, scheduling, and construction management. Mr. Kravecz's on-site experience includes the development and execution of approved work plans, the development of detailed cost estimates and approved site and spill safety plans, the application of heavy equipment and field construction requirements, performance of assessments and evaluations at hazardous waste sites, and scheduling. His supervisory experience includes familiarity with and fulfilling OSHA requirements relative to site work, coordinating transportation and disposal of hazardous wastes, soliciting and receiving bids for services and materials, recommending the lowest qualified bidder, acting as site safety officer, and preparing reports.

**Experience**

Project Manager for the remediation of DNAPLs from a lagoon and adjacent river for a confidential client in upstate New York. Site activities included "vacuuming" the bottom of the river to specified depths, with the vacuumed material being pumped to OHM's on-site treatment system for stabilization and disposal. The lagoon was remediated with a combination of pumping techniques and conventional excavation. Approximately 15,000 cubic yards of contaminated material was stabilized and disposed.

Site Manager responsible for the initial planning and setup of the Baird McGuire Superfund site project in Holbrook, Massachusetts. This project, performed under contract with the USACE New England Division, involves the excavation and on-site thermal incineration of 201,000 tons of soil and material. His duties included cost and schedule format preparation, project plan preparation, permit planning and negotiation, initial site mobilization and setup, field operations staffing, and subcontractor management. He has also provided oversight to all cost and schedule management activities.

Project Manager for the Department of the Navy at the Naval Training Center in Newport, Rhode Island This project involved the treatment of approximately 4.5 million gallons of contaminated wastewater; the collection, drumming, and disposal of 200,000 gallons of oil sludge; and the high pressure cleaning of tank interiors. Mr. Kravecz's project responsibilities included supervision of water treatment system design, preparation of a project work plan, subcontractor management, coordination of confined space entry requirements, oversight of mobile laboratory operation and QA/QC, cost and schedule control, contract negotiations, and client relations.

Managed the construction and installation of a free floating product recovery system for the USACE at Langley Air Force Base in Langley, Virginia. Mr. Kravecz was responsible for the preparation of estimates; negotiation and preparation of project-specific work plans; and providing overall management of the project, including daily work order approval, cost and schedule monitoring, and base security requirements.

Mr Kravecz, acting as OHM's Response Manager, coordinated the cleanup of a spill involving paint that had seeped from several containers within an over-the-road trailer. OHM off-loaded the undamaged containers, transferred product from damaged containers, and cleaned up the spilled paint from within the trailer.

Project Manager for the neutralization of water containing elevated levels of hydrogen sulfide by direct in-line injection of hydrogen peroxide. Approximately 200,000 gallons of liquid were treated.

Project Manager for the demolition and decontamination of a plating room and laboratory within an NSA facility. Several types of hazardous materials were encountered and cleaned during this project, including asbestos, arsenic, lead, and various acids. All decontamination work was performed in Level C PPE. Once all hazardous materials were removed, the areas were carefully disassembled. The project was completed on schedule and under budget.

Managed an Emergency Response Cleanup of gasoline spillage on a State of New Jersey roadway as a result of an automobile accident. Responded the emergency site with crew and equipment in approximately 30 minutes, and contained the spill with absorbent material, consequently drumming the sorbents for disposal.

Project Manager for the excavation, testing, transportation, and disposal of approximately 1,500 cubic yards of chromium contaminated soil at an operating facility. The project was performed in Level C personal protective equipment. The void left by the excavated soil was filled with clean backfill and compacted.

Managed the installation and maintenance of two 200 foot long product recovery trenches equipped with floating ORS pumps, to recover free floating JP-4 jet fuel from the groundwater. Eight passive well type systems were also installed in various locations throughout the base. The project was completed on budget and ahead of schedule.

Managed the processing and dewatering of petroleum waste products from within a two million gallon holding tank. The project also involved daily confined space entries into the holding tank. Approximately 150,000 gallons of sludge was processed and filter pressed into land fillable solids.

Managed the dredging and filter pressing of process waste (approximately 2,000 cubic yards) at an operating GE facility in Columbia, Maryland. The sludge was removed from concrete lagoons by the use of a "mudcat" dredge and pump to holding tanks where it was mixed with stabilizing agents then processed through a recessed plate filter press. The lagoon was successfully cleaned to visual standards.

**Experience Record**

**D.G. Harrison Construction Corporation, Project Manager/Field Operations Manager, May 1988 to July 1990,** responsible for resource allocation and management, project cost and schedule control, client negotiations, QC, and contract conformance.

**J.D. Construction Corporation, Project Engineer/Superintendent, May 1986 to May 1988,** responsible for site-specific management of projects including cost and schedule control, submittal preparation and review, resource management, QC, field data, and as-built drawing preparation, site layout, and surveying. Projects included the construction of a municipal wastewater treatment facility in Livingston, New Jersey, and the rehabilitation of 10 bridge decks for the N.J. Department of Transportation.

**Conduit & Foundation Corp., Project Engineer, June 1982 to April 1986,** responsible for site-specific management of projects including cost and schedule control, submittal preparation and review, resource management, QC, field data, and as-built drawing preparation, site layout, and surveying. Projects included the rehabilitation and enlargement of an existing railroad tunnel for the Boston and Maine Railroad.

**Academic Background**

B.S., Civil Engineering Technology, New Jersey Institute of Technology, 1982

**Specialized Training**
OSHA 40-hour Site Safety Training
OSHA 8-hour Supervisor Course
OSHA 8-hour Annual Refresher Training
OSHA Site Safety and Related Training
Fundamentals of Project Management
Team Building; Negotiating and Contracts

# *SITE SUPERVISOR'S RESUME*

# WARE WARBURTON

Mr. Warburton joined OHM in 1994, having over 12 years of technical and mechanical experience. As a site supervisor, he is responsible for on-site oversight of personnel and equipment, procurement of equipment and materials, project health and safety compliance, budgeting, scheduling, and client liaison.

## Experience

- Mr. Warburton currently serves as a site supervisor for an OHM project at the Bypass Road Landfill, Naval Weapons Station, Lackey, Virginia. This project, performed under OHM's contract with the U.S. Navy's LANTDIV, involves the excavation of an area that was contaminated with TNT. Mr. Warburton supervised the surface debris removal phase, which included writing the cost plan and the work plan, purchasing, resourcing, and equipment maintenance.

- Mr. Warburton supervised the construction of temporary holding facilities for dewatering at a bioremediation project in Craney Island, Virginia. This project was performed under OHM's LANTDIV RAC program.

- Mr. Warburton supervised the construction of a clay cap over a landfill for a confidential client in South Carolina.

- Mr. Warburton supervised work on a lead-contaminated pugmill for a bearing company in Petersburg, Virginia. Mr. Warburton's crew was responsible for assembling, lining, calibrating, and maintaining the pugmill. The crew also excavated the area around the pugmill and treated the excavated dirt. The crew also dewatered the entire area, since it was a lagoon, and set up a dewatering facility on site. Mr. Warburton supervised all on-site operations.

- Mr. Warburton supervised a landfill capping project for the U.S. Army Corps of Engineers (USACE) at Ft. Eustis in Newport News, Virginia. The project involved bringing elevations to specified grades, and covering the landfill using a heavy velum cap. The crew also installed a J-drain and filter fabrics above the velum, and placed topsoil above the velum.

In addition to his remediation experience, Mr. Warburton has considerable experience leading crews in all aspects of mechanical installations, including motors, pumps, fans, pneumatics, instrumentation, piping, and duct work. He also supervised excavation crews in all areas of machine operations, including daily operator equipment checks and services, maintenance, and proper excavation procedures.

## Specialized Training

OSHA 40-hour Training
OSHA 8-hour Refresher Training, Annually

# *SITE QC MANAGER'S RESUME*

# WARE WARBURTON

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- Mr. Warburton supervised the construction of a clay cap over a landfill for a confidential client in South Carolina.

- Mr. Warburton supervised work on a lead-contaminated pugmill for a bearing company in Petersburg, Virginia. Mr. Warburton's crew was responsible for assembling, lining, calibrating, and maintaining the pugmill. The crew also excavated the area around the pugmill and treated the excavated dirt. The crew also dewatered the entire area, since it was a lagoon, and set up a dewatering facility on site. Mr. Warburton supervised all on-site operations.

- Mr. Warburton supervised a landfill capping project for the U.S. Army Corps of Engineers (USACE) at Ft. Eustis in Newport News, Virginia. The project involved bringing elevations to specified grades, and covering the landfill using a heavy velum cap. The crew also installed a J-drain and filter fabrics above the velum, and placed topsoil above the velum.

In addition to his remediation experience, Mr. Warburton has considerable experience leading crews in all aspects of mechanical installations, including motors, pumps, fans, pneumatics, instrumentation, piping, and duct work. He also supervised excavation crews in all areas of machine operations, including daily operator equipment checks and services, maintenance, and proper excavation procedures.

## Specialized Training

OSHA 40-hour Training
OSHA 8-hour Refresher Training, Annually

# *PROGRAM QC MANAGER'S RESUME*

# MICHAEL I. GILMAN

In addition to 18 years of Engineering experience, Mr. Gilman presently holds a lead QA position at Stone & Webster Engineering Corporation. In this position, he has implemented a wide variety of QA programs involving services such as QA program review, vendor monitoring, and field inspection. His quality engineering work has included performing assessments of numerous plant QA programs, review of technical documents, preparation of inspection plans, QA procedure system development, procedure review, and continuing education. Mr. Gilman is experienced in trend analysis with the development of systems and forms to ensure the recording, transmission, and adequacy of quality data, and the use of computer and statistical techniques to collect, process, and analyze data.

## Experience

As Program Quality Control Manager for OHM's LantDiv RAC, Mr. Gilman is responsible for the enforcement of Corporate QA/QC policies and contract provisions. He works closely with the Program Manager, Mr. George Krauter, to coordinate QA/QC activities at each site to ensure they are carried out properly in support of on-going site operations. Mr. Gilman's role and responsibilities at the Program level include:

- Establishing and administering all quality matters for OHM for the LantDiv RAC
- Designating a project QC Manager for each Delivery Order
- Reviewing and approving Delivery Order QC plans
- Authorizing stop work if work activities or planning activities violate OHM quality guidelines or LantDiv RAC contract requirements
- Developing and implementing a Delivery Order specific quality control plan
- Interfacing directly with Government Quality Assurance personnel
- Conducting daily QC meetings
- Supervising performances of site QC activities
- Ensuring that QC testing is performed in accordance with specifications, and in a timely manner
- Requiring corrective actions for any item or activity which does not meet specifications or quality standards
- Modifying/halt work if activities violate LantDiv or OHM quality standards or contract requirements
- Preparing required QC certifications and documentation

Stone and Webster Environmental Technology & Services

As Section Manager of the QA Department of Stone & Webster Engineering Corporation's Cherry Hill office, he is responsible for providing guidance in the implementation of all phases of the QA programs for nuclear and fossil power plants, environmental assessment, management, and remediation, and government projects. These projects include:

- Department of the Navy - Newport News Shipbuilding
- Department of the Navy - North Div Naval Facilities Engineering Command BRAC
- Delmarva Power & Light
- New Jersey Turnpike
- Salem Generating Station - Units 1 and 2
- Hope Creek Generating Station
- River Bend Station
- Nine Mile Point Nuclear Station - Unit 2
- Calvert Cliffs Nuclear Power Plant

- Limerick Generating Station
- Fort Calhoun

Mr. Gilman has served as the Project Manager responsible for QA and other supporting department activities for services provided to a major shipyard involved in the construction and overhaul of naval vessels.

Since joining Stone & Webster, he has been assigned to the Cherry Hill office as Supervisor, QA Department Representative, QA Engineer, and Lead Engineer, and to the Boston office as an Engineer in the Reports Group of the Quality Systems Division.

Prior to joining Stone and Webster, Mr. Gilman worked in manufacturing engineering on several government projects for GTE Sylvania, the Foxboro Company, and a plastic molding manufacturer for which his responsibilities were to provide industrial engineering support for the assembly of electronic equipment, and quality control inspection and testing.

**Education**

M.S., Business Administration, Drexel University
B.S., Industrial Engineering, Northeastern University

**Specialized Training**

Hazardous Waste Operations Courses, both worker and supervisory training (per OSHA 1910.120)

**Licenses and Registrations**

American Society for Quality Control - Certified Quality Engineer
American Society for Quality Control - Member
American Nuclear Society - Delaware Valley Section - Member
American Institute of Industrial Engineers - Member

# *ATTACHMENT B*
# *INSPECTION SCHEDULE*

| ATTACHMENT B<br>INSPECTION SCHEDULE<br>FIELD SCALE TREATABILITY STUDY<br>NAVAL WEAPONS STATION, YORKTOWN, VIRGINIA<br>DELIVERY ORDER #0113<br>OHM PROJECT #08757 | | | | | | |
|---|---|---|---|---|---|---|
| **ACTIVITY** | **PREPARATORY** | **DONE** | **INITIAL** | **DONE** | **FOLLOWUP** | **DONE** |
| Erosion Control Installation | Materials meet specifications: Haybales, Silt Fence, Erosion Matting, Fertilizer, Seed, Mulch | | Proper installation, alignment and location | | Proper maintenance and on going inspection | |
| Clearing and Grubbing | Limits of clearing established | | Survey control | | Chip/remove material as required | |
| Contaminated soil excavation, backfilling | Excavation limits established<br>Haul routes established<br>Permits acquired | | Survey Control<br>Dust Control<br>Compaction between lifts | | Inspection of final grades | |
| Transportation of Contaminated Material | Specified trucks utilized | | Monitor haul route for spillage | | On-going roadway inspection | |
| Bio-cell excavation | Alignment, limits, grades | | Survey Control<br>Dust Control | | Alignment, grades, limits | |
| Liner installation | Material meets specifications | | Seams per manufacturer's specification | | In-place non-destructive testing | |

| ATTACHMENT B<br>INSPECTION SCHEDULE<br>FIELD SCALE TREATABILITY STUDY<br>NAVAL WEAPONS STATION, YORKTOWN, VIRGINIA<br>DELIVERY ORDER #0113<br>OHM PROJECT #08757 | | | | | | |
|---|---|---|---|---|---|---|
| **ACTIVITY** | **PREPARATORY** | **DONE** | **INITIAL** | **DONE** | **FOLLOWUP** | **DONE** |
| Anchor trench/rail footing | Concrete per specifications<br>Alignment, elevations, tolerances | | Survey Control | | Alignment, elevation, tolerances | |
| Simplot equipment erection | Hoisting equipment sized properly<br>Sequence of erection | | Proper installation and location | | Start up per manufacturer's specifications | |

# *ATTACHMENT C*
# *DOCUMENTATION FORMS*

# CONTRACTOR PRODUCTION REPORT

(ATTACH ADDITIONAL SHEETS IF NECESSARY)

DATE

RACT NO. | TITLE AND LOCATION | REPORT NO.

RACTOR | SUPERINTENDENT

WEATHER | MAX TEMP: °F | MIN TEMP: °F

## WORK PERFORMED TODAY

| WORK LOCATION AND DESCRIPTION | EMPLOYER | # | TRADE | HRS |
|---|---|---|---|---|
| | | | | |
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| | | | | |

JOB AFETY

WAS A JOB SAFETY MEETING HELD THIS DATE? ☐ YES ☐ NO
(If YES attach copy of the meeting minutes)

WERE THERE ANY LOST TIME ACCIDENTS THIS DATE? ☐ YES ☐ NO
(If YES attach copy of completed OSHA report)

WAS TRENCHING/SCAFFOLD/HV ELECTRICAL/HIGH WORK DONE? ☐ YES ☐ NO
(If YES attach statement or checklist showing inspection performed)

WERE THERE ANY NEAR MISS ACCIDENTS THIS DATE? ☐ YES ☐ NO
(If YES attach description of incident and proposed action)

TOTAL WORK HOURS ON JOB SITE THIS DATE

CUMULATIVE TOTAL OF WORK HOURS FROM PREVIOUS REPORT

TOTAL WORK HOURS FORM START OF CONSTRUCTION

LIST SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED

EQUIPMENT/MATERIAL RECEIVED TODAY TO BE INCORPORATED IN JOB

CONSTRUCTION AND PLANT EQUIPMENT ON JOB SITE TODAY. INCLUDE NUMBER OF HOURS USED TODAY

REMARKS

CONTRACTOR/SUPERINTENDENT

DATE

# CONTRACTOR QUALITY CONTROL REPORT

(ATTACH ADDITIONAL SHEETS IF NECESSARY)

DATE

IDENTIFY DEFINABLE FEATURE OF WORK, LOCATION AND *LIST PERSONNEL PRESENT*

Y - YES; N - NO, SEE REMARKS; BLANK - NOT APPLICABLE

## PREPARATORY

| | |
|---|---|
| | THE PLANS & SPECS HAVE BEEN REVIEWED. |
| | THE SUBMITTALS HAVE BEEN APPROVED. |
| | MATERIALS COMPLY WITH APPROVED SUBMITTALS. |
| | MATERIALS ARE STORED PROPERLY. |
| | PRELIMINARY WORK IS DONE CORRECTLY. |
| | SAFETY REQUIREMENTS HAVE BEEN MET. |
| | TESTING PLAN HAS BEEN REVIEWED. |
| | WORK METHOD/SCHEDULE DISCUSSED. |

## INITIAL

TESTING PERFORMED & WHO PERFORMED TEST

| | |
|---|---|
| | PRELIMINARY WORK IS DONE CORRECTLY. |
| | SAMPLE HAS BEEN APPROVED/PREPARED. |
| | SAFETY REQUIREMENTS HAVE BEEN MET. |
| | TEST RESULTS ARE ACCEPTABLE. |
| | WORK IS IN COMPLIANCE WITH THE CONTRACT. |

## FOLLOW-UP

TESTING PERFORMED & WHO PERFORMED TEST

| | |
|---|---|
| | WORK COMPLIES WITH CONTRACT AS APPROVED IN INITIAL PHASE. |

REWORK ITEMS IDENTIFIED TODAY (NOT CORRECTED BY CLOSE OF BUSINESS)

REWORK ITEMS CORRECTED TODAY (FROM REWORK LOG)

REMARKS

On behalf of the contractor, I certify that this report is complete and correct and all equipment and material used and work performed during this reporting period is in compliance with the contract plans and specifications to the best of my knowledge except as noted above.

AUTHORIZED CQC MANAGER AT SITE

DATE

# GOVERNMENT QUALITY ASSURANCE REPORT

DATE

QUALITY ASSURANCE REPRESENTATIVE'S REMARKS AND/OR EXCEPTIONS TO THE REPORT

GOVERNMENT QUALITY ASSURANCE REPRESENTATIVE

DATE

# *FIGURES*

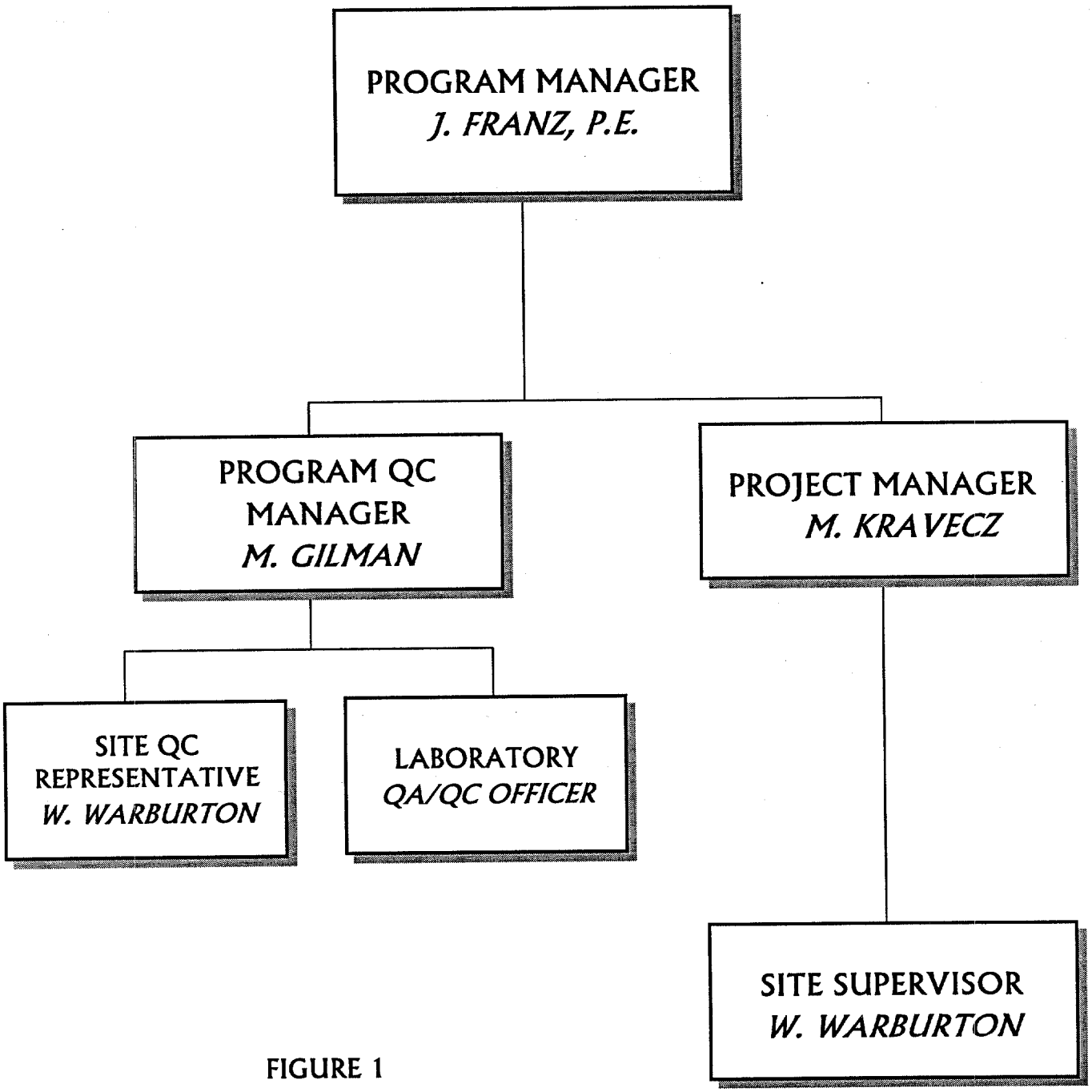


FIGURE 1

QC ORGANIZATION CHART

Delivery Order 0113
OHM Project 18757

Prepared for

DEPARTMENT OF THE NAVY
ATLANTIC DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORFOLK, VA

**OHM Remediation Services Corp.**

# *APPENDIX B*
# *EROSION AND SEDIMENT CONTROL PLAN*

OHM Remediation Services Corp.
A Subsidiary of OHM Corporation

# EROSION AND SEDIMENTATION CONTROL PLAN
# BIOCELL CONSTRUCTION
# NAVAL WEAPONS STATION YORKTOWN
# YORKTOWN, VIRGINIA
# DELIVERY ORDER NO. 0113

Prepared for:

DEPARTMENT OF THE NAVY
Atlantic Division
Naval Facilities Engineering Command
LRA, Building A, Room 3700
6500 Hampton Blvd.
Norfolk, Virginia 23508-1297

Prepared by:

OHM Remediation Services Corp.
1000 RIDC Plaza, Suite 600
Pittsburgh, Pennsylvania 15238-2928

Reviewed by:

Mark Kravecz
Project Manager

John P. Franz, P.E.
Program Manager

August 5, 1996
OHM Project 18757ESC

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# *EROSION AND SEDIMENTATION CONTROL PLAN*

## 1.0 INTRODUCTION

### 1.1 PURPOSE

This plan describes the erosion and sedimentation control measures to be used during earthmoving activities for biocell construction and soil excavation at the Naval Weapons Station Yorktown, Yorktown, Virginia. The purpose of this plan is to present the design information for the construction of erosion and sedimentation controls as required by the Virginia Department of Environmental Quality (VADEQ) Bureau of Soil and Water Conservation. This plan contains the information required in the Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation Document *"Virginia Erosion and Sedimentation Control Handbook,"* Third Edition, 1992.

### 1.2 SITE HISTORY AND BACKGROUND INFORMATION

Site history and background information pertaining to Sites 6 and 7 are presented in the following subsections.

#### 1.2.1 Site 6 - Explosives-Contaminated Wastewater Impoundment

Site 6 contains an unlined surface impoundment and surrounding drainage area located adjacent to wetlands along a small tributary to Felgates Creek. The Site 6 impoundment area was formerly used (1942 to 1975) to receive contaminated wastewater from the explosives reclamation facility at Building 109 and from weapons loading operations at Building 110. The reclamation facility released solvents such as trichloroethene, trichloroethane, and cyclohexane, and explosive compounds such as trinitrotoluene (TNT) and hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX). The weapons loading operations released select solvents and explosives. The impoundment area was used as a settling basin for explosive-contaminated washdown water. Currently, the impoundment collects only surface runoff from the area between Buildings 109 and 110.

#### 1.2.2 Site 7 - Plant 3 Explosives-Contaminated Wastewater Discharge Area

Site 7 is a small drainage area located adjacent to wetlands and along a small tributary to Felgates Creek. The Site 7 discharge area received explosives-contaminated wastewater from Loading Plant 3 during 1945 to 1975. The weapons loading operations released select solvents and explosives to the drainage area. Currently, the drainage way has reverted to a natural drainage area and receives no discharge from the Plant 3 complex.

#### 1.2.3 Summary of Previous Investigation Results

A variety of environmental investigations have been conducted at Sites 6 and 7. Most recently, a Round Two remedial investigation (RI) was conducted. A complete presentation of contaminants detected in various media at these sites is presented in the Round Two RI Report (Baker, 1996).

Soil and sediment samples colleted from these sites were analyzed for a wide range of parameters, including nitramine/nitroaromatic compounds (i.e., explosives). Maximum concentrations of explosives detected in soil/sediment at Sites 6 and 7 during the Round One RI and the Round Two RI are presented in Tables 1-1 and 1-2, respectively.

1.2.4 Results of the Bench-Scale Treatability Study

This section reviews the preliminary results of the bench-scale treatability study recently conducted for explosives-contaminated soil at the Naval Weapons Station Yorktown. It is noted that a final report and conclusions are not available at this time. The Naval Weapons Station Yorktown, in conjunction with the Department of the Navy (DoN) Naval Facilities Engineering Command, Atlantic Division (LANTDIV) and Baker, have assessed the extent of explosives contamination at the Naval Weapons Station Yorktown sites, and evaluated various remediation approaches. As part of remediation technology assessments, LANTDIV tasked Waterways Experimental Station (WES) to perform a treatability study to determine the feasibility of remediating explosives-contaminated soil at the Naval Weapons Station Yorktown. This bench-scale treatability study included three soil treatment techniques: anaerobic biotreatment, aerobic biotreatment, and SlurOx treatment. The objectives of the study were to assess and maximize the explosive-degrading potential of indigenous Naval Weapons Station Yorktown soil microbial communities using microcosms of bioslurry or biocell treatment systems. The bioslurry represents the highest level of mixing available; whereas, the biocell is a static system. It is noted that due to preliminary results, the SlurOx system was eliminated from consideration as a possible remediation technique ans was not further evaluation as part of the bench-scale study. The following remediation technologies were selected for investigation:

- Aerobic Biocell
- Anaerobic Biocell
- Aerobic Bioslurry
- Anaerobic Bioslurry.

The bench-scale treatability for Naval Weapons Station Yorktown was completed in phases. Phase I (conducted from January to May 1995) consisted of the selection of soil samples; collection, homogenization, and shipment of the samples; soil sample storage; the homogenization and sieving of samples; and chemical and physical characterization of the soil sample. Phase II (conducted from June to July 1995) included the assessment of explosive-degrading potential of soil microflora, selection of enrichments of TNT-degrading microorganisms, assessment of the efficacy of adding exogenous microorganisms to bacteria-contaminated soil, and evaluation of the effects of adding the surfactant Tween 80 to the soil during biotreatment. Phase III (conducted from August to September 1995) included selection of surfactant dose and sequential batch tests. Phase IV (conducted from November 1995 to April 1996) was the bioslurry bench-scale study and Phase V (conducted from November 1995 to April 1996) was the biocell bench-scale study. Finally, Phase VI is the reporting phase of the study. WES is currently completing this final phase.

Representative soil samples from several sites at the Naval Weapons Station Yorktown were studied in microcosms designed to simulate bench-scale bioslurry and biocell treatment systems. TNT was mixed into soil samples and the samples were incubated for 48 hours. The degradation of TNT was determined by monitoring the disappearance of TNT, the appearance of TNT metabolites, and the evolution of carbon dioxide. The effects of the various treatments on the microbial community in the soil were measured by monitoring the total respiration of the soil microbial community n the microcosms and by analysis of polar membrane lipids.

Two types of streams were tested for biocell and bioslurry bench-scale test: aerobic and anaerobic. The treatment systems to be used in the bench-scale studies were determined based on the results from Phases II and III. The aerobic biocell studies included the following two treatments:

- Sterile control
- Tween 80 and molasses.

The anaerobic biocell studies included:

- Potato starch
- Tween 80 and molasses
- Simplot method
- Molasses
- Sterile control.

The aerobic bioslurry studies included the following treatments:

- Sterile control
- No additives
- Tween 80 and molasses.

The anaerobic bioslurry studies included the following treatments:

- Potato starch
- Simplot method
- Simplot method with 4-hour mixing
- Sterile control.

The bioslurry and biocell systems were sampled routinely over a 10- to 12-week period for explosives and explosive-related compounds. Soil was sampled and analyzed from the biocell and both soil and water collected from the bioslurry system were analyzed. The following subsections discuss the results from each study.

### 1.2.5 Biocell Results

The anaerobic biocell was not as successful as the anaerobic biocells in the reduction of explosive compounds. The Tween 80 and molasses (aerobic) only demonstrated a 25-percent reduction in total explosives and a 31-percent reduction in TNT in 49 days in the biocell. Whereas, the anaerobic systems (Tween 80 and molasses; molasses, Simplot; and potato starch) all showed greater than a 90-percent reduction of TNT by Day 49.

### 1.2.6 Bioslurry Results

By Day 21 of the bioslurry study, total explosives were degraded by 89 percent and TNT was degraded by 99.6 percent by the molasses treatment system in the aerobic bioslurry. Anaerobic bioslurry successfully degraded TNT; however, concentrations of RDX, octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX), and dinitrotoluenes did not appear to degrade as fast as in the biocells. The bioslurry indicated that there was not significant difference between containuous Simplot mixing and the 4-hour Simplot mixing. By Day 21, total explosives were only degraded by 66 percent by the potato starch and

59 percent by the Simplot mixture; however, TNT was degraded by 96 percent with the potato starch and 90 percent with the Simplot mixture.

1.2.7 Bench-Scale Study Conclusions

The final bench-scale treatability study report has not been completed. Nonetheless, WES has concluded that based on the results from the bench-scale studies, the aerobic bioslurry technology utilizing native soil consortia, Tween 80 and molasses and the anaerobic biocell utilizing the Simplot process to be the two most potentially effective treatment methods for the Naval Weapons Station Yorktown soil.

Based on the results of the bench-scale treatability study, LANTDIV has decided to further the evaluation of the effectiveness of the Simplot technology by conducting a field-scale pilot study at the Naval Weapons Station Yorktown. LANTDIV may decide to conduct a pilot study implementing the Tween 80 and molasses bioslurry in the future.

## 1.3 OBJECTIVES

The objective of this plan is to present erosion and sedimentation control measures to allow the biocell construction and soil excavation activities to take place and to minimize any threat to the adjacent waterways. The work covered under this plan includes installation of silt fence and strawbale checkdams. Maintenance of these facilities for the duration of the capping project is included as part of this task. The plan will utilize all of the above-mentioned control measures in combination to minimize soil erosion and sediment accumulation.

# 2.0 SOIL CHARACTERISTICS

This plan includes five figures (Figures 1, 2, 3, 4, and 5) which are described below. The proposed erosion and sedimentation controls and project areas are depicted on these figures. Figures 1 and 2 depicts existing project features, Figure 3 and 4 depicts the layout of erosion and sedimentation controls, and Figure 5 shows erosion and sedimentation details.

## 2.1 SOIL TYPES

Four soil types are present at the Naval Weapons Station Yorktown. The four soil types are as follows:

- Urban Land
- Urban Land - Udorthents
- Udorthents, Loamy
- Udorthents, Clayey.

## 2.2 PHYSICAL CHARACTERISTICS

The soil series as described in the current United States Department of Agriculture (USDA) - Soil Conservation Service Soil Survey of York County and Newport News City are listed in the following sections. The soil survey should be consulted for definitions of terminology.

2.2.1 Urban Land

Urban Land soils are altered, reworked, or removed soil material in "areas where more than 70 percent of the land surface is covered by asphalt, concrete, buildings, or other impervious materials" (USDA, 1989).

2.2.2 Urban Land - Udorthents

Urban Land - Udorthents soils "have been graded, cut, filled, or disturbed by construction and earthmoving activities" (USDA, 1989). This soil complex has an urban setting and occupies gentle slopes and areas of moderately well and poorly draining Udorthents soils.

2.2.3 Udorthents, Loamy

Udorthents, Loamy soils are "soil material in areas where the soil has been altered during excavation or covered by earthly fill material" (USDA, 1989). This soil complex has an urban setting near transportation arteries, manmade waterways and mining activities. Generally, Udorthents are well-to-moderately-well-drained loamy and sandy material.

2.2.4 Udorthents, Clayey

Udorthents, Clayey soils consist "mostly of clayey fill material that has been placed on soils of various drainage classes on lowlying terraces, floodplains, and tidal marshes" (USDA, 1989). This soil complex has a slow-to-very-slow permeability allowing water to pond easily on its surface. This results in little threat of erosional episodes taking place. Due to the perpetual wetness and slow permeability of Udorthents, Clayey soils, their use for civil construction is limited.

## 3.0 PROJECT ACTIVITIES

The project entails the construction of an earth soil/geomembrane double-lined treatment cell. The project activities are primarily site preparation work (drainage control and site setup); excavation activities to construct the treatment cell and excavation at Site 7.

### 3.1 SITE PREPARATION

Construction activities that will impact runoff during site preparation include the following:

- Clearing and grubbing
- Temporary road construction.

Local temporary control measures will be utilized as segments of the project area are cleared and grubbed to construct the erosion and sedimentation controls.

### 3.2 SOIL EXCAVATION

Soil excavation will be performed as required to construct haul roads, the treatment cell, and at Site 7. At a minimum, prior to excavation, local control measures, such as silt fence and/or strawbale checkdams, will be installed on the downslope side of the excavation. Additionally, the area around, as

well as the excavation (where possible), will be graded such that all runoff passes through erosion and sedimentation control structures.

### 3.3 SOIL PLACEMENT

Soil placement will be performed to construct the haul roads and the treatment cell. Prior to soil placement beginning, at a minimum, silt fence and strawbale checkdams will be installed on the downslope side of the fill area. The erosion and sedimentation controls will be in place prior to beginning the major soil placement activities for the cell construction. As backfill is placed, the fill area will be graded such that all runoff passes through erosion and sedimentation control structures. Any erosion and sedimentation control structure that is installed/constructed during soil placement activities will remain in place until the site is vegetated.

### 3.4 STORMWATER RUNOFF

The biocell area is on a plateau. Existing runon is diverted around the area via a drainage swale on the north side of the site and an existing culvert northwest of the site. Stormwater runoff from the treatment cell will pass through erosion and sedimentation control features prior to discharge.

## 4.0 CONTROL MEASURES

This section describes the various temporary and permanent erosion and sedimentation controls that will be used during earthmoving activities at the site. All controls will comply with the manufacturer's installation specifications and will be installed as directed by the Navy technical representative or OHM Remediation Services Corp. (OHM), a wholly owned subsidiary of OHM Corporation, site supervisor. All control measures will be installed in accordance with Appendix A - Technical Specifications.

### 4.1 TEMPORARY CONTROLS

#### 4.1.1 Silt Fence

Silt fence will be installed as shown on Figure 5 and in the locations shown on Figures 3 and 4. At a minimum, silt fence will be installed on all downslope sides of either excavation or backfilling activities. It will be installed as part of the site preparation work and will be in place locally prior to all construction activities.

#### 4.1.2 Strawbale Checkdams

Strawbales will be used in places where flow over disturbed areas must be minimized until vegetation is established. This includes on the downslope of excavations for the erosion and sedimentation controls.

### 4.2 PERMANENT CONTROLS

Permanent controls for biocell construction excavation area restoration will include vegetation of disturbed areas (Figures 3 and 4) and placement of jute matting as necessary and as shown on Figure 4.

4.2.1 Vegetation

The following sections discuss the requirement for establishing vegetation over the project area in accordance with Standard Specification 3.32 - "Permanent Seeding" of the VESCH Manual (see Appendix A - Technical Specifications).

4.2.1.1 Seedbed Preparation

Prior to seeding, the soil will be prepared to create a seedbed to enhance seed germination, optimize root growth, increase infiltration of water to the root zone, and minimize erosion. The seedbed will be prepared using suitable construction equipment to loosen the upper 4 inches of soil. Fertilizer and other additives will be added to the soil as part of seedbed preparation.

4.2.1.2 Seed Mixture

Seeding will be accomplished by either a truck-mounted broadcast seeder or hydroseeder, or by seed drill. The seed will be covered with either a thin veneer (minimum 1/4 inch) of soil or mulch, unless the seed is applied using hydroseeding methods. The seed permanent mixture will consist of:

- Tall Fescue - 190 to 200 pounds per acre
- Kentucky Bluegrass - 0 to 10 pounds per acre.

The temporary seed mixture will consist of:

- Annual Ryegrass - 1.7 pounds per acre
- Cereal Rye - 2 pounds per acre.

4.2.1.3 Mulch

The areas fertilized and seeded will also be mulched to reduce germination time and improve overall growth. All areas will be mulched with straw or hay applied at the rate of 2 tons per acre. Straw mulch will be of healthy stacks from oats, wheat, rye, barley, or rice containing at least 50 percent by weight of material that is 10 inches or longer. Application will be performed on the same day as seeding and will be placed by a blower. Mulch will be held in place using either mulch netting or chemical tack. The anchor method and materials for the netting will be as specified by the net manufacturer. Chemical tack will be a cornstarch base applied by the hydroseeder.

Wood cellulose recycled paper mulch may be used as an alternative to straw or hay. Wood cellulose mulch would be applied by a hydroseeded at a rate of 1,000 pounds per acre.

Excelsior wood fiber mats will be used in areas with slopes steeper than 2H:1V and collection channels.

4.2.1.4 Fertilizer and Lime

The fertilizer will be a 10-20-10 controlled release, commercial grade, granular, free-flowing blend of nitrogen, phosphoric acid, and potassium. Fifty percent of the nitrogen will be of the slow release organic type. The mixture will be derived from either sulfur-coated urea, urea formaldehyde, plastic- or

polymer-coated prills, or isobutylenediurea. The application rate will be determined based on the analytical results of soil samples. The final fertilizer selection will also be based on the analytical results of the soil.

Lime will be from agricultural grade limestone. The limestone will be ground so that a minimum of 90 percent passes through a 10-mesh sieve and a minimum of 50 percent passes through a 100-mesh sieve. The application rate for lime will be assumed at 4 tons per acre, however, the final application rate will be based on analytical results of soil samples.

Both the lime and fertilizer will be incorporated into the top 4 inches of soil during seedbed preparation or will be applied along with the seed if hydroseeding is the method or application.

#### 4.2.2 Jute Matting

Jute matting will be installed at Site 7 during restoration activities. The existing site conditions at Site 7 range from gradually sloping to moderately steep. The jute matting will help stabilize the bare soil until vegetation is established. The matting will be placed in the moderately steep area shown on Figure 4 and in accordance with VESCH Standard Specification 3.36 (Appendix A).

#### 4.2.3 Entrance Road

The existing gravel entrance road will be upgraded in accordance with Appendix A to minimize tracking of mud and sediment off site.

### 4.3 MAINTENANCE

OHM will be responsible for the proper maintenance of all seeded and mulched areas for the Navy-specified duration after demobilization of the project. Upon removal of the silt fence, the area covered by the silt fence will be regraded and reseeded as needed. OHM will also maintain the silt fence and strawbale checkdams while construction for the treatment cell and Site 7 restoration is being performed. OHM will inspect the drainage facilities weekly and after large storm events, and will repair areas as required.

## 5.0 RUNOFF

### 5.1 PROJECT AREAS

All runoff from the project area to be disturbed for treatment cell construction will be collected and conveyed to the erosion and sedimentation control facilities.

### 5.2 UPSTREAM WATERSHED

The upstream watershed is currently diverted around this site and will not affect construction activities.

### 5.3 IMPACT

The impact to the watershed from project activities will be minimal with the erosion and sedimentation control features provided in this plan.

## 6.0 EARTHMOVING ACTIVITIES

### 6.1 GENERAL

The project activities that require erosion and sedimentation controls are site preparation, soil excavation, and soil placement. These are described in the following sections.

#### 6.1.1 Site Preparation

Construction activities that will impact runoff during site preparation include the following:

- Clearing and grubbing
- Temporary road construction.

All excavations will be graded such that all runoff passes through erosion and sedimentation control structures, either permanent or temporary, prior to discharge from the site.

#### 6.1.2 Soil Excavation

Soil excavation will be performed as required to construct haul roads, the treatment cell, and Site 7 soil excavation. At a minimum, prior to excavation, silt fence or silt fence and strawbale checkdams will be installed on the downslope side of the excavation additionally.

#### 6.1.3 Soil Placement

Prior to soil placement, at a minimum, silt fence and strawbale checkdams will be installed on the downslope side of the fill area. Additionally, as a backfill is placed, the fill area will be graded such that all runoff passes through erosion and sedimentation control structures. Any erosion and sedimentation control structure that is installed/constructed during soil placement activities will remain in place until the site is vegetated.

# *TABLES*

TABLE 1-1

SUMMARY OF MAXIMUM EXPLOSIVE COMPOUND
CONCENTRATIONS DETECTED IN SITE 6 - SOIL AND SEDIMENT SAMPLES
PILOT SCALE TREATABILITY STUDY WORK PLAN
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA

| *Detected Explosive Compounds* | *Maximum Detected Concentration (µg/kg)* | | | | | | *Overall Maximum Concentration* |
|---|---|---|---|---|---|---|---|
| | *Round One RI* | | *Round Two RI* | | *Round Two Conformational Sampling* | *Treatability Study Characterization Sampling* | |
| | *Soil* | *Sediment* | *Soil* | *Sediment* | *Sediment* | *Sediment* | |
| HMX | 61,000 | 710,000 | ND | ND | 730,000 | 21,000 | 730,000 |
| RDX | 160,000 | 160,000 | ND | ND | 3,900,000 | 194,000 | 3,900,000 |
| 1,3,5-Trinitrobenzene | 21,000 | 19,000 | ND | 450 | 120,000 | 1,320 | 120,000 |
| 1,3-Dinitrobenzene | ND | ND | ND | 210 | 4,600 | 3,760 | 4,600 |
| Nitrobenzene | ND | ND | ND | ND | 2,100 | ND | 2,100 |
| Tetryl | ND | ND | ND | ND | 70,000 | ND | 70,000 |
| 2,4,6-TNT | 640,000 | ND | ND | 2,500,000 | 93,000,000 | 2,690,000 | 93,000,000 |
| 2,4-Dinitrotoluene | ND | 28,000 | ND | ND | ND | 382 | 28,000 |
| Amino-Dinitrotoluene | ND | ND | ND | ND | ND | 7,310 | 7,310 |
| 4-Amino-Dinitrotoluene | ND | ND | 2,500 | 520,000 | 160,000 | ND | 520,000 |
| 2-Amino-Dinitrotoluene | ND | ND | 2,500 | ND | 160,000 | ND | 160,000 |

Notes:

ND = Not Detected.

**TABLE 1-2**

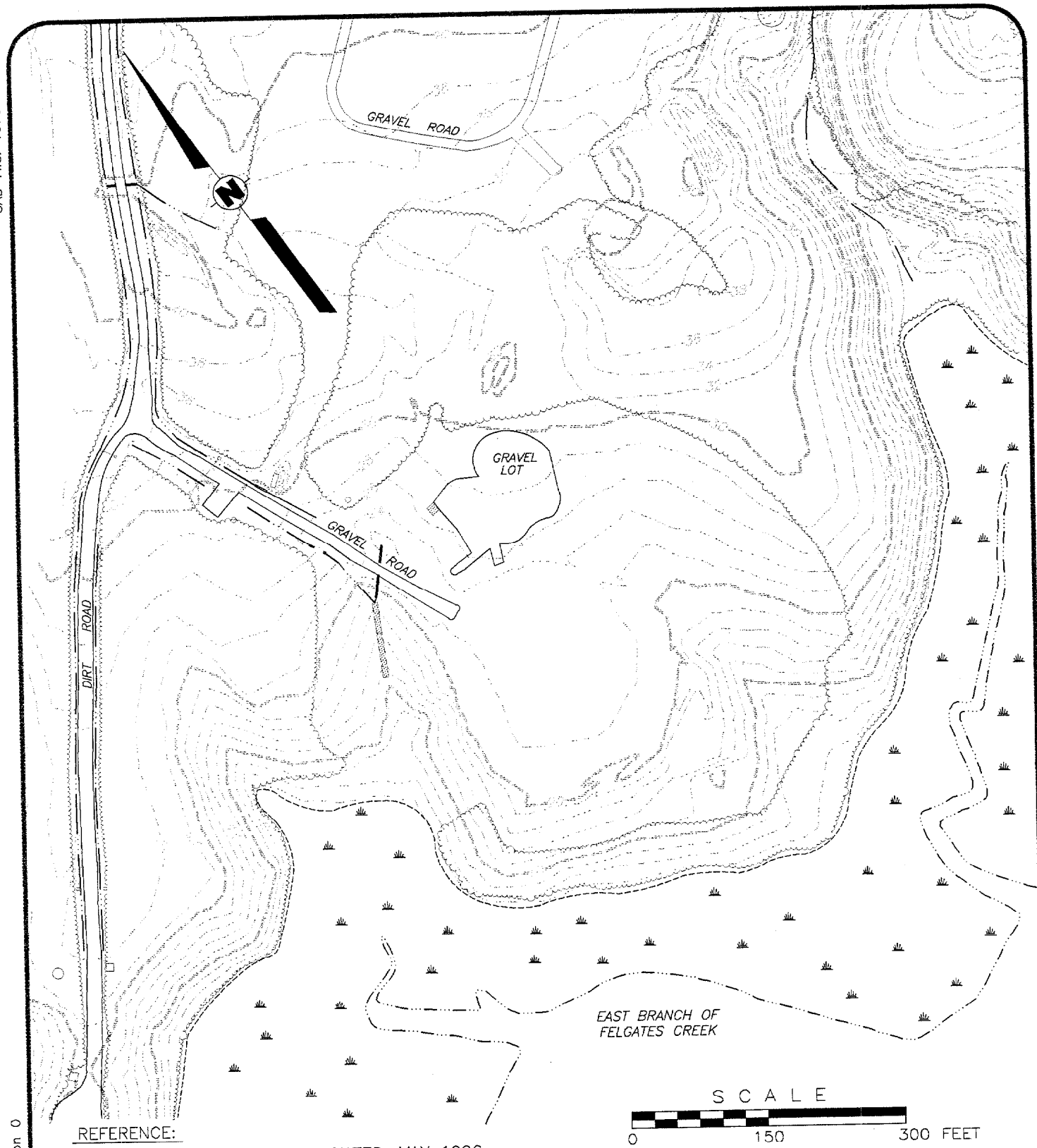
**SUMMARY OF MAXIMUM EXPLOSIVE COMPOUND CONCENTRATIONS DETECTED IN SITE 7 - SOIL AND SEDIMENT SAMPLES PILOT SCALE TREATABILITY STUDY WORK PLAN NAVAL WEAPONS STATION YORKTOWN YORKTOWN, VIRGINIA**

| | *Maximum Detected Concentration (µg/kg)* | | |
|---|---|---|---|
| | *Round One RI* | *Round Two RI* | *Treatability Study Characterization Sampling* |
| *Detected Explosive Compounds* | *Soil and Sediment* | *Soil and Sediment* | *Sediment* |
| HMX | ND | ND | 3,200,000 |
| RDX | ND | ND | 14,000,000 |
| 2,4,6-TNT | ND | ND | 40,000,000 |
| Amino-Dinitrotoluene | ND | ND | 84,700 |

Notes:

ND = Not Detected.

# *FIGURES*




REFERENCE:
MILLER–STEPHENSON & ASSOCIATES, MAY 1996.

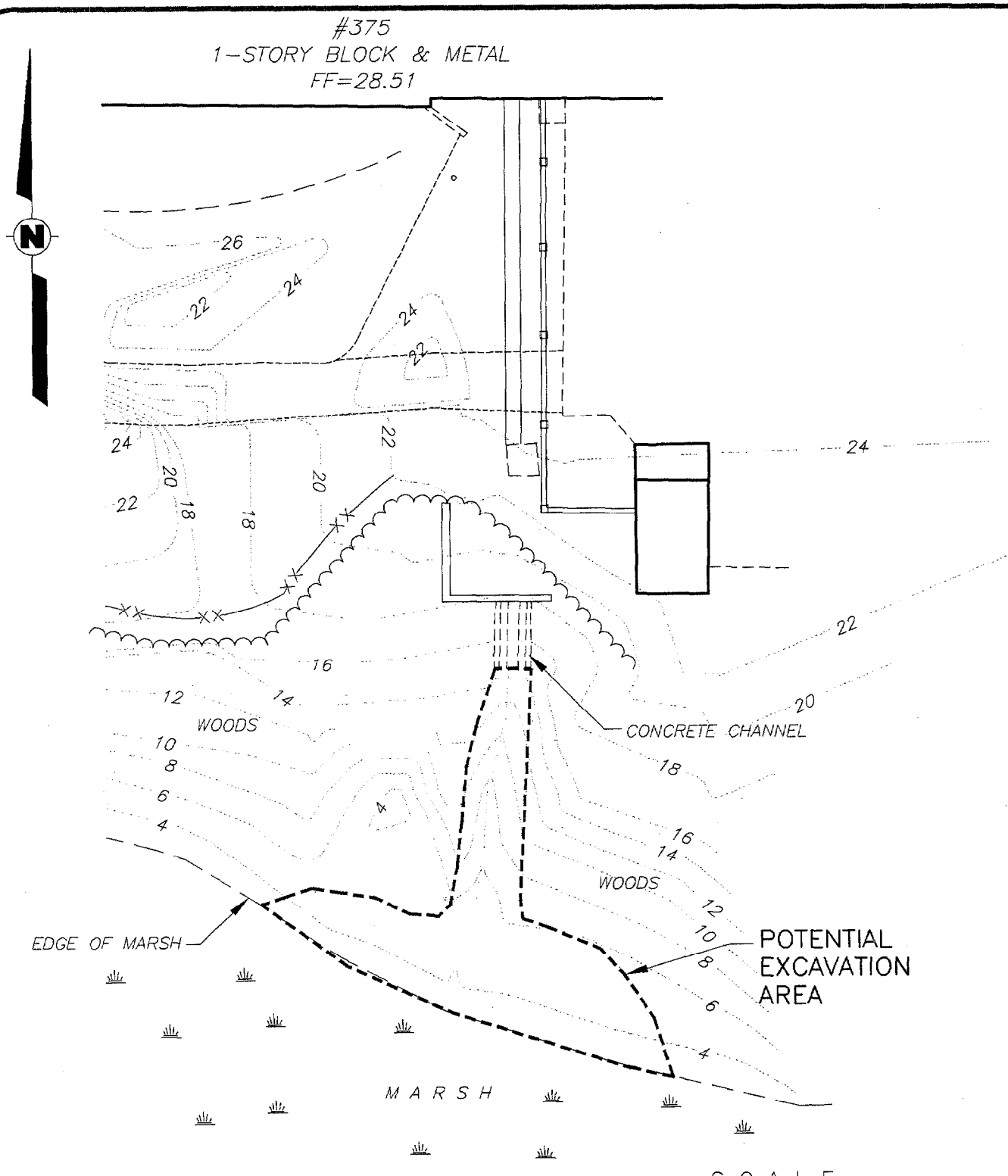
CAD File: 18757-A1

Plot Scale: 1 = 150 revision 0

**OHM Remediation Services Corp.**
OHM Project No. 18757

| Drawn By: | Checked By: | Approved By: |
|---|---|---|
| A. Smith | J. Faison | M. Kravecz |
| Date: | Scale: | Drawing No. |
| 8/5/96 | N.T.S. | 18757–A1 |

FIGURE 1
EXISTING CONDITIONS – BIOTREATMENT CELL
SITE 7 REMOVAL ACTION
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA
PREPARED FOR
DEPARTMENT OF THE NAVY – ATLANTIC DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORFOLK, VIRGINIA




REFERENCE:

MILLER-STEPHENSON & ASSOC., JULY 1996

SCALE

0 30 60 FEET

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OHM Project No. 18757

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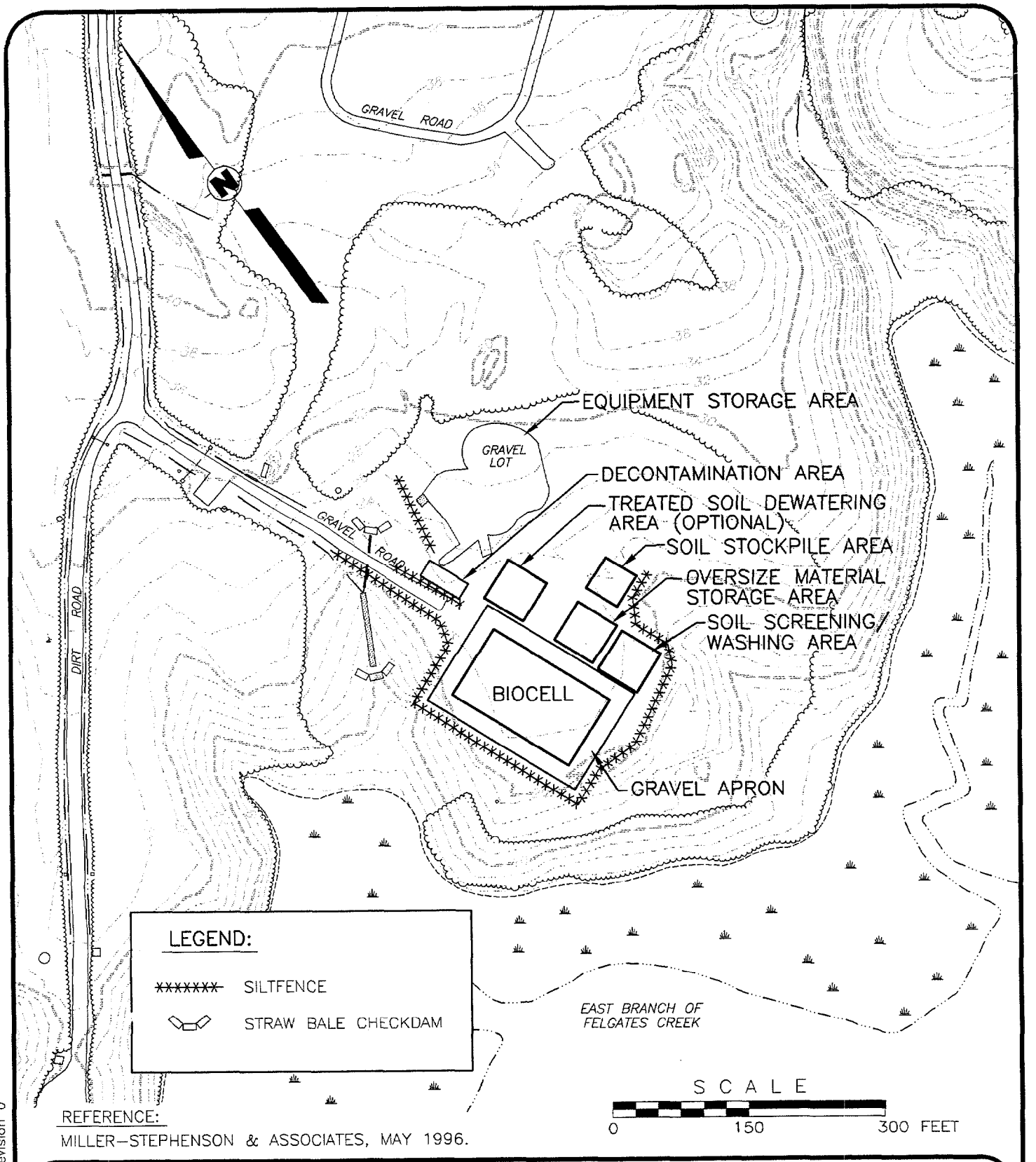
FIGURE 2
EXISTING CONDITIONS - SITE 7
SITE 7 REMOVAL ACTION
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

PREPARED FOR

DEPARTMENT OF THE NAVY - ATLANTIC DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORFOLK, VIRGINIA

CAD File: 18757-A2

Plot Scale: 1 = 30 revision 0




REFERENCE:
MILLER–STEPHENSON & ASSOCIATES, MAY 1996.

**OHM Remediation Services Corp.**
OHM Project No. 18757

| Drawn By: | Checked By: | Approved By: |
|---|---|---|
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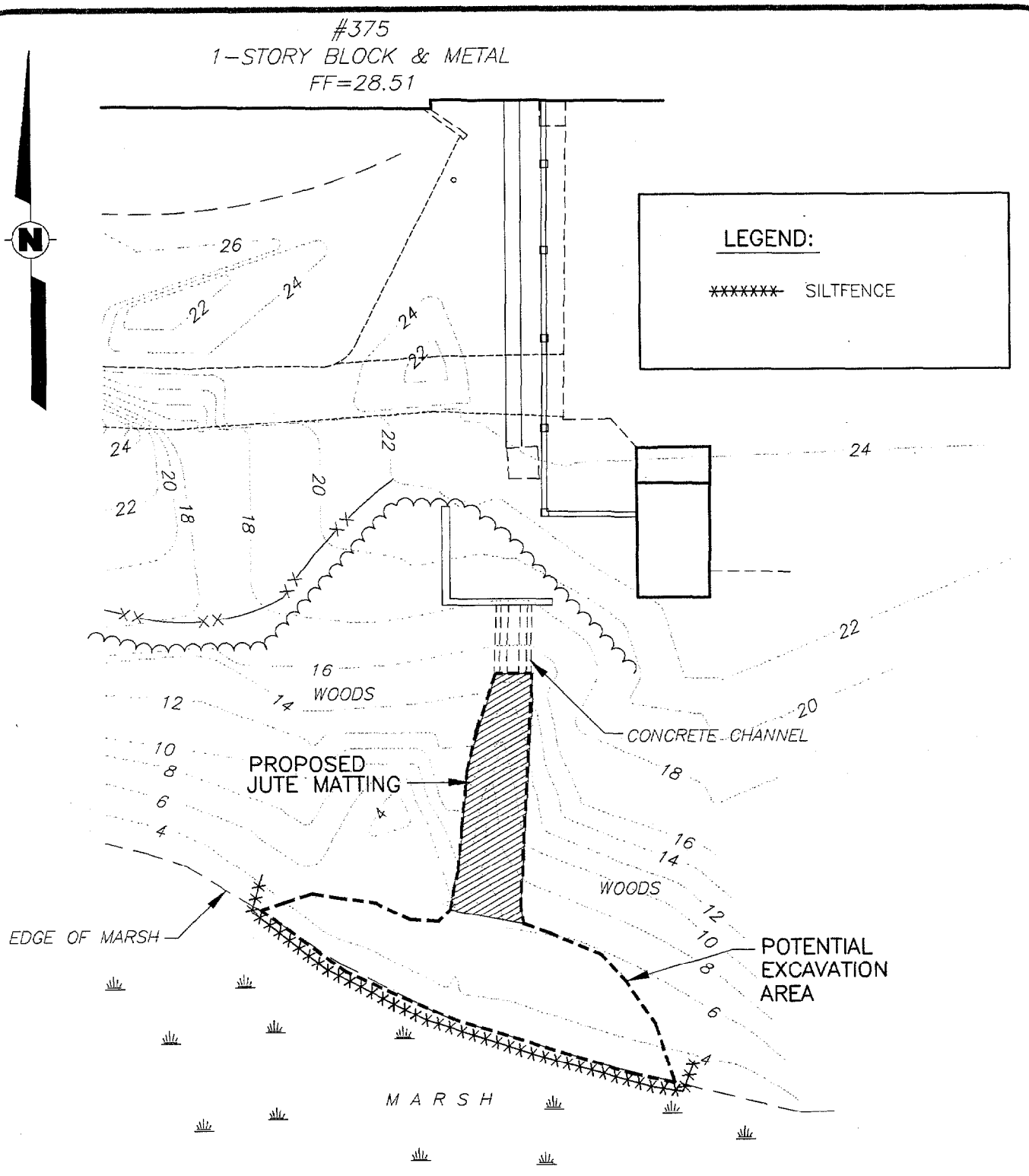
| Date: | Scale: | Drawing No. |
| 8/5/96 | N.T.S. | 18757–A3 |

FIGURE 3
EROSION & SEDIMENT LAYOUT – BIOTREATMENT CELL
SITE 7 REMOVAL ACTION
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA
PREPARED FOR
DEPARTMENT OF THE NAVY – ATLANTIC DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORFOLK, VIRGINIA

CAD File: 18757–A3
Plot Scale: 1 = 150 revision 0




REFERENCE:

MILLER-STEPHENSON & ASSOC., JULY 1996

**OHM Remediation Services Corp.**

OHM Project No. 18757

| Drawn By: | Checked By: | Approved By: |
|---|---|---|
| A. Smith | J. Faison | M. Kravecz |
| Date: | Scale: | Drawing No. |
| 8/5/96 | N.T.S. | 18757-A4 |

FIGURE 4

EROSION & SEDIMENT LAYOUT - SITE 7

SITE 7 REMOVAL ACTION

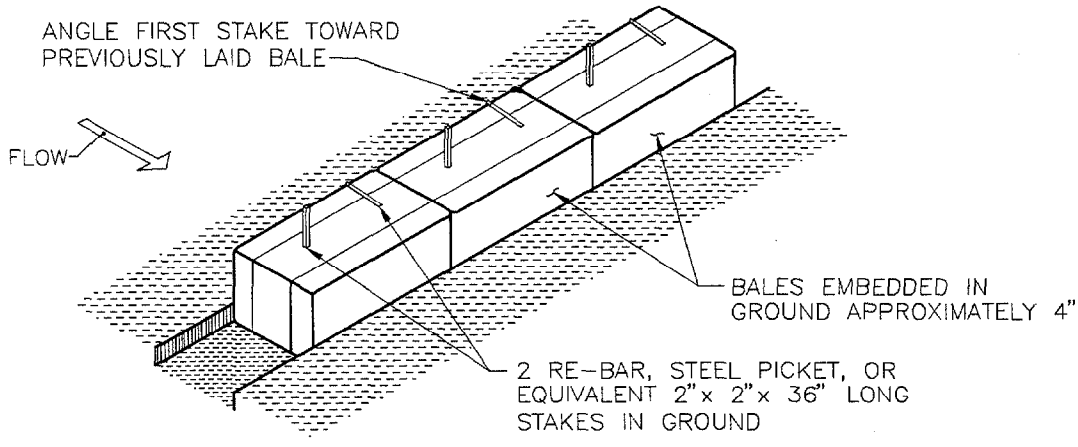
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

PREPARED FOR

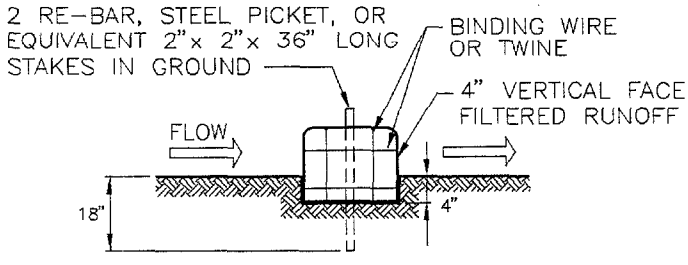
DEPARTMENT OF THE NAVY - ATLANTIC DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORFOLK, VIRGINIA

CAD File: 18757-A4

Plot Scale: 1 = 30 revision 0




ANCHORING DETAIL

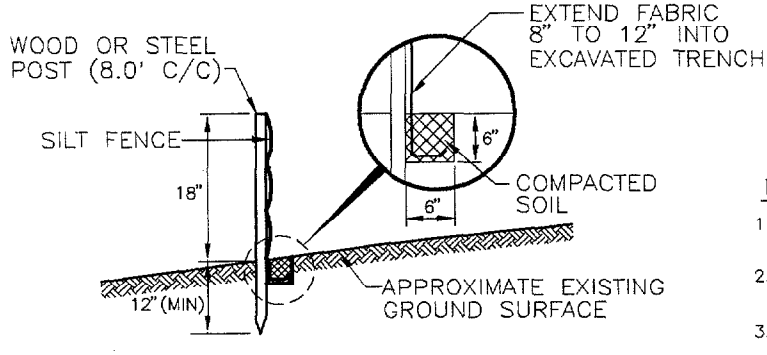



EMBEDDING DETAIL

NOTES:

1. BALES SHALL BE PLACED IN A ROW WITH ENDS TIGHTLY ABUTTING THE ADJACENT BALES.
2. EACH BALE SHALL BE EMBEDDED IN THE SOIL A MINIMUM OF 4".
3. BALES SHALL BE SECURELY ANCHORED IN PLACE BY STAKES OR RE-BARS DRIVEN THROUGH THE BALES. THE FIRST STAKE IN EACH BALE SHALL BE ANGLED TOWARD PREVIOUSLY LAID BALE TO FORCE BALES TOGETHER.
4. BALES TO BE PLACED AS SHOWN ON THE PLANS OR AS OTHERWISE DIRECTED.

## DETAIL (1)
## STRAW BALE CHECKDAM INSTALLATION




## DETAIL (2)
## SILT FENCE INSTALLATION

NOTES:

1. TAKE ALL SLACK OUT OF FABRIC BEFORE ATTACHING TO STAKES.
2. FENCE TO BE PLACED AS SHOWN ON THE PLANS OR AS OTHERWISE DIRECTED.
3. SILT FENCE WILL BE REMOVED AFTER SEEDING HAS ACHIEVED ADEQUATE GROWTH TO PREVENT EROSION OR AS OTHERWISE DIRECTED.
4. FOLLOW ADDITIONAL PROCEDURES FOUND IN THE TECHNICAL SPECIFICATIONS.

**OHM Remediation Services Corp.**
OHM Project No. 18757

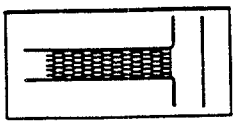
| Drawn By: | Checked By: | Approved By: |
|---|---|---|
| A. Smith | J. Faison | M. Kravecz |
| Date: | Scale: | Drawing No. |
| 8/5/96 | N.T.S. | 18757-A5 |

FIGURE 5
DETAILS – SILT FENCE, STRAWBALE
SITE 7 REMOVAL ACTION
NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA
PREPARED FOR
DEPARTMENT OF THE NAVY – ATLANTIC DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORFOLK, VIRGINIA

CAD File: 18757-A5
Plot Scale: 1 = 1 revision 0

# *APPENDIX A*
# *TECHNICAL SPECIFICATIONS*

STD & SPEC 3.02



# TEMPORARY STONE CONSTRUCTION ENTRANCE

CE

## Definition

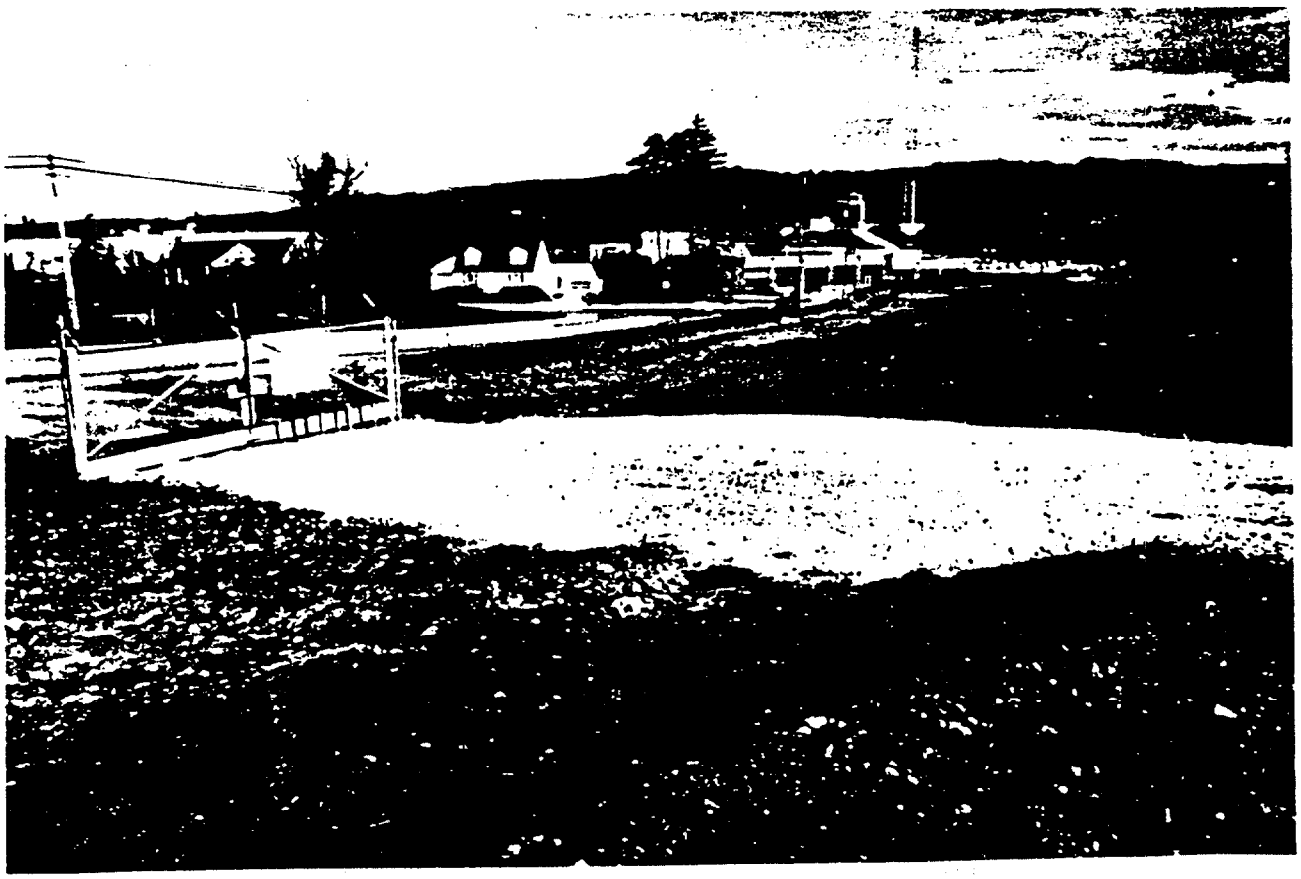
A stabilized stone pad with a filter fabric underliner located at points of vehicular ingress and egress on a construction site.

## Purpose

To reduce the amount of mud transported onto paved public roads by motor vehicles or runoff.

## Conditions Where Practice Applies

Wherever traffic will be leaving a construction site and move directly onto a public road or other paved area.



## Planning Considerations

Minimum Standard #17 (MS #17) requires that provisions be made to minimize the transport of sediment by vehicular traffic onto a paved surface. Construction entrances provide an area where a significant amount of mud can be removed from construction vehicle tires before they enter a public road and, just as important, the soil adjacent to the paved surface can be kept intact. A filter fabric liner is used as a "separator" to minimize the dissipation of aggregate into the underlying soil due to construction traffic loads. If the action of the vehicles traveling over the gravel pad is not sufficient to remove the majority of the mud or there exists an especially sensitive traffic situation on the adjacent paved road, the tires must be washed before the vehicle enters the public road. If washing is necessary, provisions must be made to intercept the wash water and trap the sediment so it can be collected and stabilized. Construction entrances should be used in conjunction with the stabilization of construction roads (see Std. & Spec. 3.03, CONSTRUCTION ROAD STABILIZATION) to reduce the amount of mud picked up by construction vehicles and to do a better job of mud removal. Other innovative techniques for accomplishing the same purpose (such as a bituminous entrance) can be utilized, but only after specific plans and details are submitted to and approved by the appropriate Plan-Approving Authority.

## Design Criteria

### Aggregate Size

VDOT #1 Coarse Aggregate (2- to 3-inch stone) should be used.

### Entrance Dimensions

The aggregate layer must be at least 6 inches thick; a minimum three inches of aggregate should be placed in a cut section to give the entrance added stability and to help secure filter cloth separator. It must extend the full width of the vehicular ingress and egress area and have a minimum 12-foot width. The length of the entrance must be at least 70 feet (see Plate 3.02-1).

### Washing

If conditions on the site are such that the majority of the mud is not removed by the vehicles traveling over the stone, then the tires of the vehicles must be washed before entering the public road. Wash water must be carried away from the entrance to a approved settling area to remove sediment. All sediment shall be prevented from entering storm drains, ditches, or watercourses. A wash rack may also be used to make washing more convenient and effective (see Plate 3.02-1).

### Location

The entrance should be located to provide for maximum utilization by all construction vehicles.

## Construction Specifications

The area of the entrance must be excavated a minimum of 3 inches and must be cleared of all vegetation, roots, and other objectionable material. The filter fabric underliner will then be placed the full width and length of the entrance.

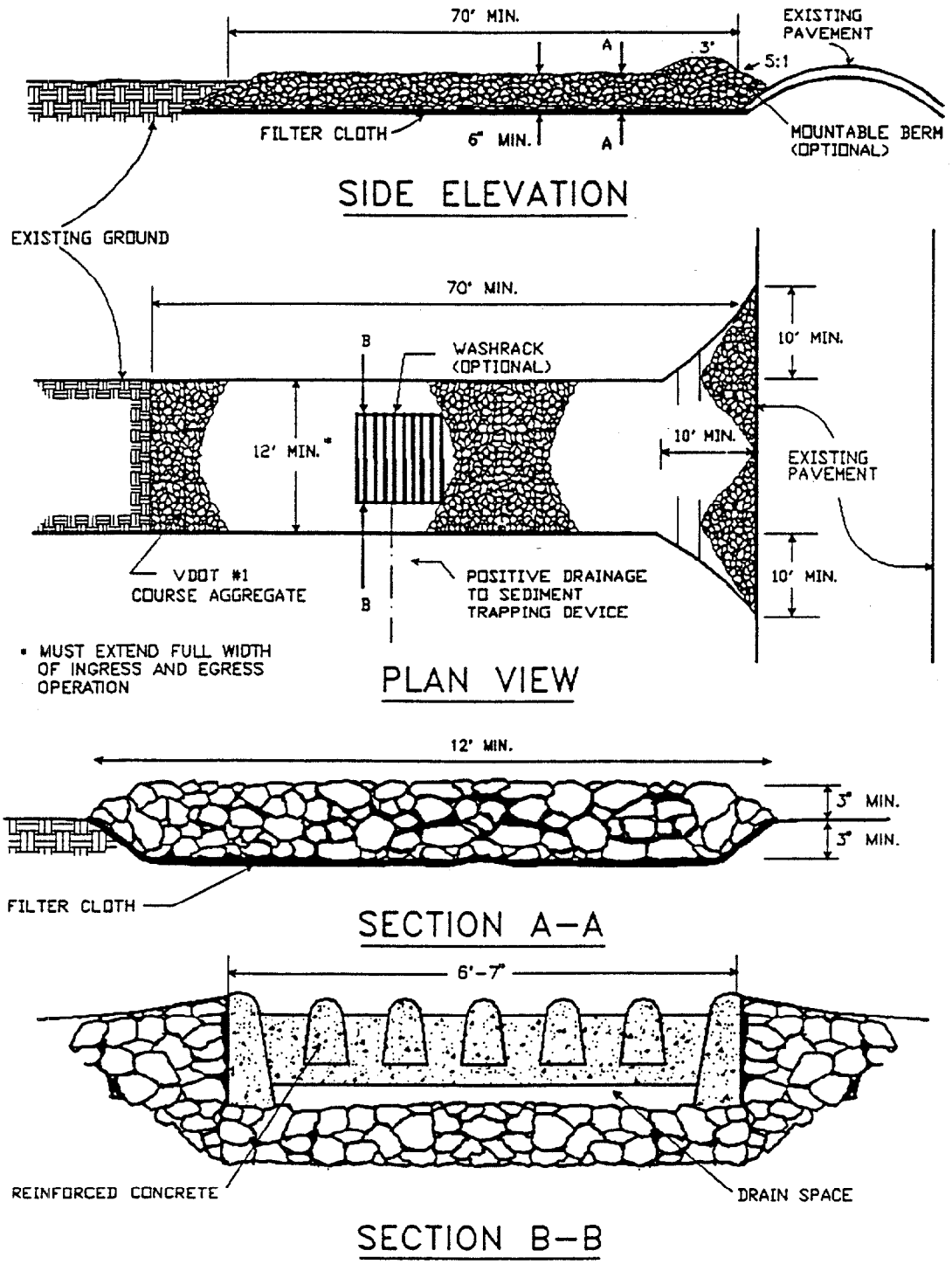
Following the installation of the filter cloth, the stone shall be placed to the specified dimensions. If wash racks are used, they should be installed according to manufacturer's specifications. Any drainage facilities required because of washing should be constructed according to specifications. Conveyance of surface water under entrance, through culverts, shall be provided as required. If such conveyance is impossible, the construction of a "mountable" berm with 5:1 slopes will be permitted.

The filter cloth utilized shall be a woven or nonwoven fabric consisting only of continuous chain polymeric filaments or yarns of polyester. The fabric shall be inert to commonly encountered chemicals and hydrocarbons, be mildew and rot resistant, and conform to the physical properties noted in Table 3.02-A.

## Maintenance

The entrance shall be maintained in a condition which will prevent tracking or flow of mud onto public rights-of-way. This may require periodic top dressing with additional stone or the washing and reworking of existing stone as conditions demand and repair and/or cleanout of any structures used to trap sediment. All materials spilled, dropped, washed, or tracked from vehicles onto roadways or into storm drains must be removed immediately. The use of water trucks to remove materials dropped, washed, or tracked onto roadways will not be permitted under any circumstances.

# STONE CONSTRUCTION ENTRANCE




Source: Adapted from 1983 Maryland Standards for Soil Erosion and Sediment Control, and Va. DSWC

Plate 3.02-1

**TABLE 3.02-A**

**CONSTRUCTION SPECIFICATIONS FOR FILTER CLOTH UNDERLINER**

| Fabric Properties[1] | Light-Duty Entrance[2] (Graded Subgrade) | Heavy-Duty Entrance[3] (Rough Graded) | Test Method |
|---|---|---|---|
| Grab Tensile Strength (lbs.) | 200 | 220 | ASTM D1682 |
| Elongation at Failure (%) | 50 | 220 | ASTM D1682 |
| Mullen Burst Strength (lbs.) | 190 | 430 | ASTM D3786 |
| Puncture Strength (lbs.) | 40 | 125 | ASTM D751 (modified) |
| Equivalent Opening Size (mm) | 40-80 | 40-80 | U.S. Standard Sieve CW-02215 |

[1] Fabrics not meeting these specifications may be used only when design procedure and supporting documentation are supplied to determine aggregate depth and fabric strength.

[2] Light Duty Entrance: Sites that have been graded to subgrade and where most travel would be single axle vehicles and an occasional multi-axle truck. Examples of fabrics which can be used are: Trevira Spunbond 1115, Mirafi 100X, Typar 3401, or equivalent.

[3] Heavy Duty Entrance: Sites with only rough grading and where most travel would be multi-axle vehicles. Examples of fabrics which can be used are: Trevira Spunbond 1135, Mirafi 600X, or equivalent.

Source: Virginia Highway and Transportation Research Council (VHTRC)

STD & SPEC 3.04

# STRAW BALE BARRIER

STB

## Definition

A temporary sediment barrier consisting of a row of entrenched and anchored straw bales.

## Purposes

1. To intercept and detain small amounts of sediment from disturbed areas of limited extent in order to prevent sediment from leaving the construction site.

2. To decrease the velocity of sheet flows.

## Conditions Where Practice Applies

1. Below disturbed areas subject to sheet and rill erosion.

2. Where the size of the drainage area is no greater than one-fourth of an acre per 100 feet of barrier length; the maximum slope length behind the barrier is 100 feet; and the maximum slope gradient behind the barrier is 50 percent (2:1).

3. Where effectiveness is required for less than 3 months.

4. Under no circumstances should straw bale barriers be constructed in live streams or in swales where there is the possibility of a washout.

5. The measure should not be used where water may concentrate in defined ditches and minor swales.

6. Straw bale barriers shall not be used on areas where rock or another hard surface prevents the full and uniform anchoring of the barrier.

## Planning Considerations

Based on observations made in Virginia, Pennsylvania, Maryland and other parts of the nation, straw bale barriers have not been as effective as many users had hoped they would be - especially when used to slow down and filter concentrated flows. They should be used judiciously and with caution as erosion control measures. There are three major reasons for such ineffectiveness.

First, improper utilization of straw bale barriers has been a major problem. Straw bale barriers have been used in streams and drainageways where high water depth and velocities have destroyed or damaged the control. Secondly, improper placement and installation of the barriers, such as staking the bales directly to the ground with no soil seal or entrenchment, has allowed undercutting and end flow. This has resulted in additions of, rather than removal of, sediment from runoff waters. Finally, inadequate maintenance lowers the effectiveness of these barriers. Trapping efficiencies of carefully installed straw bale barriers on one project in Virginia dropped from 57% to 16% in one month due to lack of maintenance.

There are serious questions about the continued use of straw bale barriers as they are presently installed and maintained. Averaging from $3 to $6 per linear foot, the thousands of straw bale barriers used annually in Virginia represent such a considerable expense that optimum installation procedures should be emphasized.

## Design Criteria

A formal design is not required. However, an effort should be made to locate the straw bale barrier, as well as other perimeter controls, at least 5 to 7 feet from the base of disturbed slopes with grades greater than 7%. This will help prevent the measure from being rendered useless following the initial movement of soil.

## Construction Specifications

### Sheet Flow Application

1. Bales shall be placed in a single row, lengthwise on the contour, with ends of adjacent bales tightly abutting one another.

2. All bales shall be either wire-bound or string-tied. Straw bales shall be installed so that bindings are oriented around the sides rather than along the tops and bottoms of the bales in order to prevent deterioration of the bindings (see Plate 3.04-1).

3. The barrier shall be entrenched and backfilled. A trench shall be excavated the width of a bale and the length of the proposed barrier to a minimum depth of 4 inches. After the bales are staked and chinked (gaps filled by wedging), the excavated soil shall be backfilled against the barrier. Backfill soil shall conform to the ground level on the downhill side and shall be built up to 4 inches against the uphill side of the barrier (see Plate 3.04-1).

4. Each bale shall be securely anchored by at least two stakes (minimum dimensions 2 inches x 2 inches x 36 inches) or standard "T" or "U" steel posts (minimum weight of 1.33 pounds per linear foot) driven through the bale. The first stake or steel post in each bale shall be driven toward the previously laid bale to force the bales together. Stakes or steel pickets shall be driven a minimum 18 inches deep into the ground to securely anchor the bales.

5. The gaps between bales shall be chinked (filled by wedging) with straw to prevent water from escaping between the bales. Loose straw scattered over the area immediately uphill from a straw bale barrier tends to increase barrier efficiency.

6. Inspection shall be frequent and repair or replacement shall be made promptly as needed.

7. Straw bale barriers shall be removed when they have served their usefulness, but not before the upslope areas have been permanently stabilized.

## Maintenance

1. Straw bale barriers shall be inspected immediately after each rainfall and at least daily during prolonged rainfall.

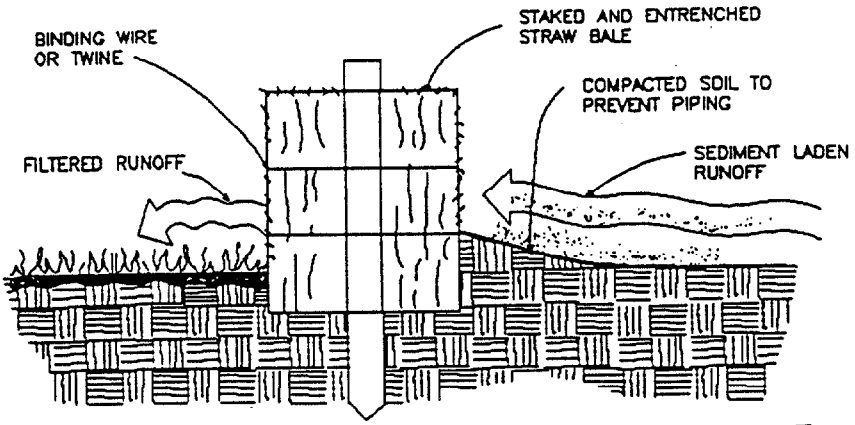
2. Close attention shall be paid to the repair of damaged bales, end runs and undercutting beneath bales.

3. Necessary repairs to barriers or replacement of bales shall be accomplished promptly.

4. Sediment deposits should be removed after each rainfall. They must be removed when the level of deposition reaches approximately one-half the height of the barrier.

5. Any sediment deposits remaining in place after the straw bale barrier is no longer required shall be dressed to conform to the existing grade, prepared and seeded.

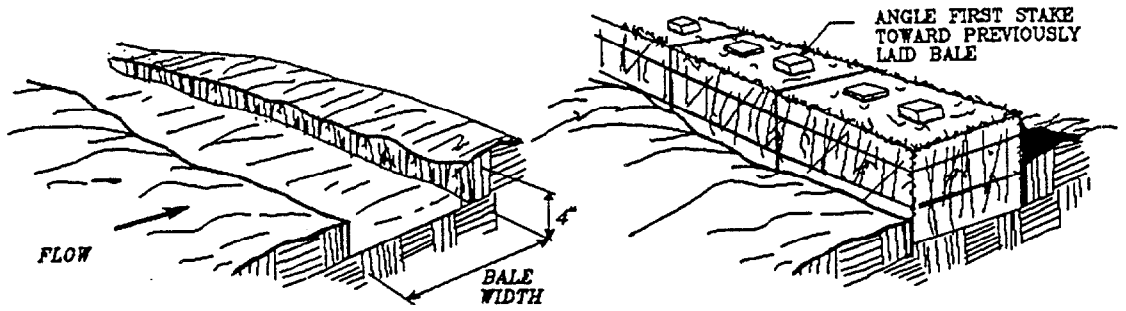
# STRAW BALE BARRIER

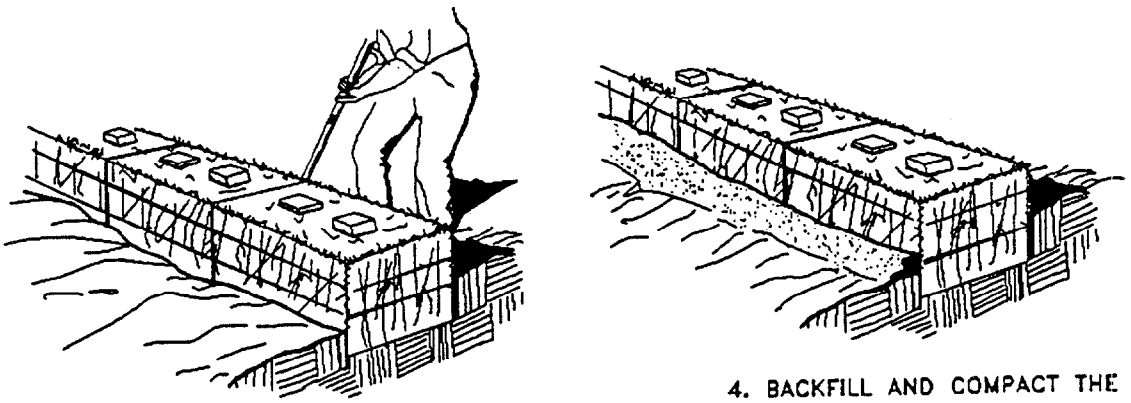



PROPERLY INSTALLED STRAW BALE
(CROSS SECTION)

1. EXCAVATE THE TRENCH.

2. PLACE AND STAKE STRAW BALES.



3. WEDGE LOOSE STRAW BETWEEN BALES.

4. BACKFILL AND COMPACT THE EXCAVATED SOIL.

CONSTRUCTION OF STRAW BALE BARRIER

Source: Va. DSWC

Plate 3.04-1

STD & SPEC 3.05

# SILT FENCE

SF

## Definition

A temporary sediment barrier consisting of a synthetic filter fabric stretched across and attached to supporting posts and entrenched.

## Purposes

1. To intercept and detain small amounts of sediment from disturbed areas during construction operations in order to prevent sediment from leaving the site.

2. To decrease the velocity of sheet flows and low-to-moderate level channel flows.

## Conditions Where Practice Applies

1. Below disturbed areas where erosion would occur in the form of sheet and rill erosion.

2. Where the size of the drainage area is no more than one quarter acre per 100 feet of silt fence length; the maximum slope length behind the barrier is 100 feet; and the maximum gradient behind the barrier is 50 percent (2:1).

3. In minor swales or ditch lines where the maximum contributing drainage area is no greater than 1 acre and flow is no greater than 1 cfs.

4. Silt fence will not be used in areas where rock or some other hard surface prevents the full and uniform depth anchoring of the barrier.

## Planning Considerations

Laboratory work at the Virginia Highway and Transportation Research Council (VHTRC) has shown that silt fences can trap a much higher percentage of suspended sediments than straw bales, though silt fence passes the sediment-laden water slower. Silt fences are preferable to straw barriers in many cases because of their durability and potential cost savings. While the failure rate of silt fences is lower than that of straw barriers, many instances have been observed where silt fences are improperly installed, inviting failure and sediment loss. The installation methods outlined here can improve performance and reduce failures.

As noted, flow rate through silt fence is significantly lower than the flow rate for straw bale barriers. This creates more ponding and hence more time for sediment to fall out. Table 3.05-A demonstrates these relationships.

Both woven and non-woven synthetic fabrics are commercially available. The woven fabrics generally display higher strength than the non-woven fabrics and, in most cases, do not require any additional reinforcement. When tested under acid and alkaline water conditions, most of the woven fabrics increase in strength, while the reactions of non-woven fabrics to these conditions are variable. The same is true of testing under extensive ultraviolet radiation. Permeability rates vary regardless of fabric type. While all of the fabrics demonstrate very high filtering efficiencies for sandy sediments, there is considerable variation among both woven and non-woven fabrics when filtering the finer silt and clay particles.

## Design Criteria

1. No formal design is required. As with straw bale barriers, an effort should be made to locate silt fence at least 5 feet to 7 feet beyond the base of disturbed slopes with grades greater than 7%.

**TABLE 3.05-A**

**TYPICAL FLOW RATES AND FILTERING EFFICIENCIES OF PERIMETER CONTROL**

| Material | Flow Rate (gal./sq.ft./min) | Filter Efficiency(%) |
|---|---|---|
| Straw | 5.6 | 67 |
| Synthetic Fabric | 0.3 | 97 |

Source: VHTRC

2. The use of silt fences, because they have such a low permeability, is limited to situations in which only sheet or overland flows are expected and where concentrated flows originate from drainage areas of 1 acre or less.

3. Field experience has demonstrated that, in many instances, silt fence is installed too short (less than 16 inches above ground elevation). The short fence is subject to breaching during even small storm events and will require maintenance "clean outs" more often. Properly supported silt fence which stands 24 to 34 inches above the existing grade tends to promote more effective sediment control.

## Construction Specifications

### Materials

1. Synthetic filter fabric shall be a pervious sheet of propylene, nylon, polyester or ethylene yarn and shall be certified by the manufacturer or supplier as conforming to the requirements noted in Table 3.05-B.

2. Synthetic filter fabric shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0° F to 120° F.

3. If wooden stakes are utilized for silt fence construction, they must have a diameter of 2 inches when oak is used and 4 inches when pine is used. Wooden stakes must have a minimum length of 5 feet.

**TABLE 3.05-B**

**PHYSICAL PROPERTIES OF FILTER FABRIC IN SILT FENCE**

| Physical Property | Test | Requirements |
|---|---|---|
| Filtering Efficiency | ASTM 5141 | 75% (minimum) |
| Tensile Strength at 20% (max.) Elongation* | VTM-52 | Extra Strength - 50 lbs./linear inch (minimum)<br>Standard Strength - 30 lbs./linear inch (minimum) |
| Flow Rate | ASTM 5141 | 0.2 gal./sq.ft./ minute (minimum) |
| Ultraviolet Radiation Stability % | ASTM-G-26 | 90% (minimum) |

* Requirements reduced by 50% after six months of installation.

Source: VHTRC

4. If steel posts (standard "U" or "T" section) are utilized for silt fence construction, they must have a minimum weight of 1.33 pounds per linear foot and shall have a minimum length of 5 feet.

5. Wire fence reinforcement for silt fences using standard-strength filter cloth shall be a minimum of 14 gauge and shall have a maximum mesh spacing of 6 inches.

Installation

1. The height of a silt fence shall be a minimum of 16 inches above the original ground surface and shall not exceed 34 inches above ground elevation.

2. The filter fabric shall be purchased in a continuous roll cut to the length of the barrier to avoid the use of joints. When joints are unavoidable, filter cloth shall be spliced together only at a support post, with a minimum 6-inch overlap, and securely sealed.

3. A trench shall be excavated approximately 4-inches wide and 4-inches deep on the upslope side of the proposed location of the measure.

4. When wire support is used, standard-strength filter cloth may be used. Posts for this type of installation shall be placed a maximum of 10-feet apart (see Plate 3.05-1). The wire mesh fence must be fastened securely to the upslope side of the posts using heavy duty wire staples at least one inch long, tie wires or hog rings. The wire shall extend into the trench a minimum of two inches and shall not extend more than 34 inches above the original ground surface. The standard-strength fabric shall be stapled or wired to the wire fence, and 8 inches of the fabric shall be extended into the trench. The fabric shall not be stapled to existing trees.

5. When wire support is not used, extra-strength filter cloth shall be used. Posts for this type of fabric shall be placed a maximum of 6-feet apart (see Plate 3.05-2). The filter fabric shall be fastened securely to the upslope side of the posts using one inch long (minimum) heavy-duty wire staples or tie wires and eight inches of the fabric shall be extended into the trench. The fabric shall not be stapled to existing trees. This method of installation has been found to be more commonplace than #4.

6. If a silt fence is to be constructed across a ditch line or swale, the measure must be of sufficient length to eliminate endflow, and the plan configuration shall resemble an arc or horseshoe with the ends oriented upslope (see Plate 3.05-2). Extra-strength filter fabric shall be used for this application with a maximum 3-foot spacing of posts.

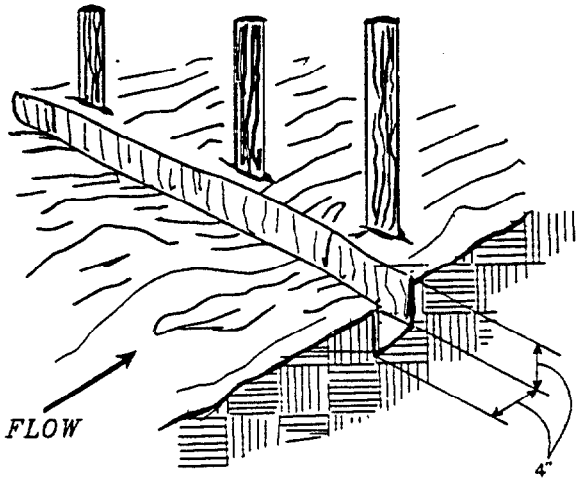
   All other installation requirements noted in #5 apply.

7. The 4-inch by 4-inch trench shall be backfilled and the soil compacted over the filter fabric.

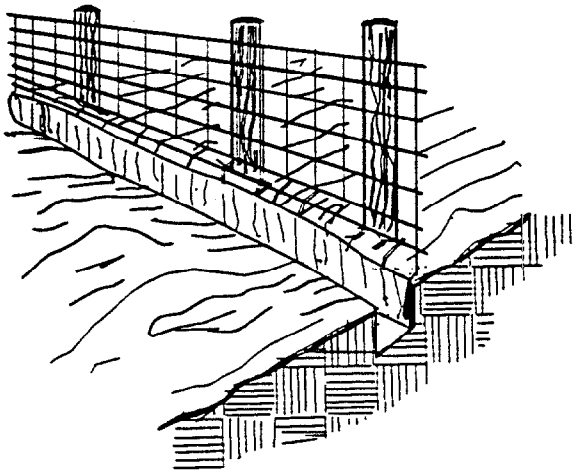
8. Silt fences shall be removed when they have served their useful purpose, but not before the upslope area has been permanently stabilized.

# CONSTRUCTION OF A SILT FENCE (WITH WIRE SUPPORT)

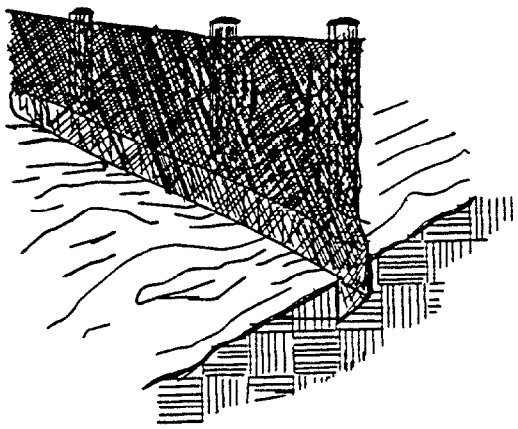
1. SET POSTS AND EXCAVATE A 4"X4" TRENCH UPSLOPE ALONG THE LINE OF POSTS.



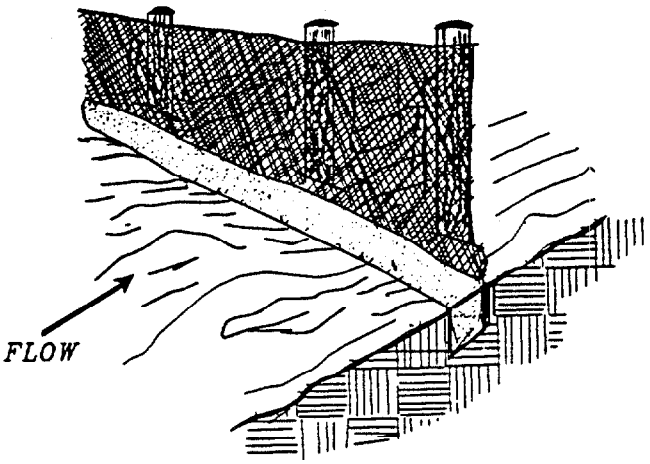

2. STAPLE WIRE FENCING TO THE POSTS.



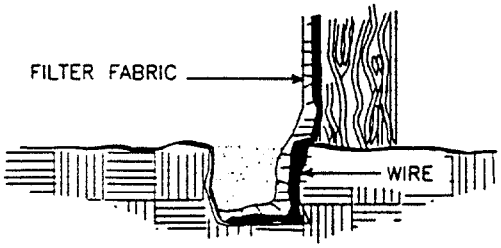
3. ATTACH THE FILTER FABRIC TO THE WIRE FENCE AND EXTEND IT INTO THE TRENCH.



4. BACKFILL AND COMPACT THE EXCAVATED SOIL.




EXTENSION OF FABRIC AND WIRE INTO THE TRENCH.

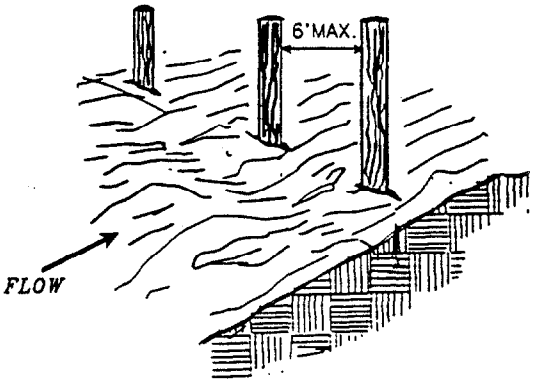



Source: Adapted from Installation of Straw and Fabric Filter Barriers for Sediment Control, Sherwood and Wyant

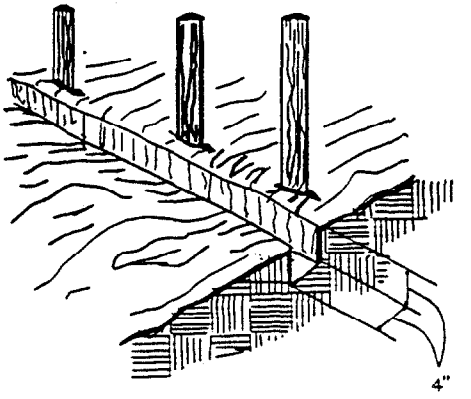
Plate 3.05-1

# CONSTRUCTION OF A SILT FENCE (WITHOUT WIRE SUPPORT)

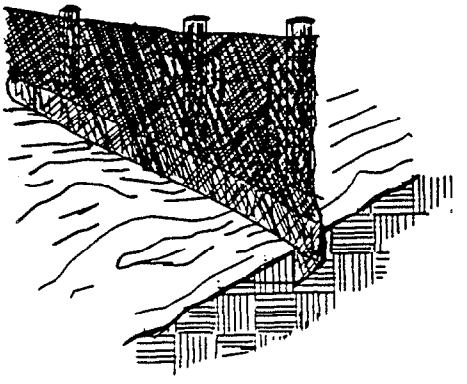
1. SET THE STAKES.



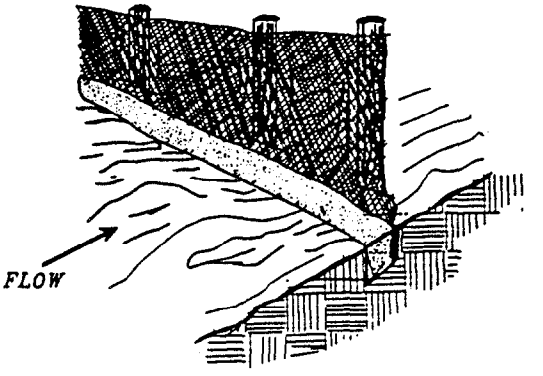

2. EXCAVATE A 4"X 4" TRENCH UPSLOPE ALONG THE LINE OF STAKES.



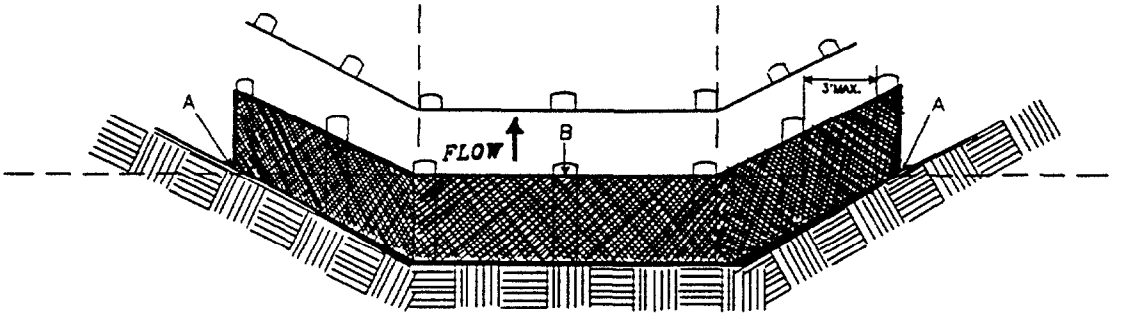

3. STAPLE FILTER MATERIAL TO STAKES AND EXTEND IT INTO THE TRENCH.



4. BACKFILL AND COMPACT THE EXCAVATED SOIL.




SHEET FLOW INSTALLATION
(PERSPECTIVE VIEW)




POINTS A SHOULD BE HIGHER THAN POINT B.

DRAINAGEWAY INSTALLATION
(FRONT ELEVATION)

Source: Adapted from Installation of Straw and Fabric Filter Barriers for Sediment Control, Sherwood and Wyant

Plate 3.05-2

## Maintenance

1. Silt fences shall be inspected immediately after each rainfall and at least daily during prolonged rainfall. Any required repairs shall be made immediately.

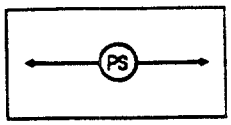
2. Close attention shall be paid to the repair of damaged silt fence resulting from end runs and undercutting.

3. Should the fabric on a silt fence decompose or become ineffective prior to the end of the expected usable life and the barrier still be necessary, the fabric shall be replaced promptly.

4. Sediment deposits should be removed after each storm event. They must be removed when deposits reach approximately one-half the height of the barrier.

5. Any sediment deposits remaining in place after the silt fence is no longer required shall be dressed to conform with the existing grade, prepared and seeded.

STD & SPEC 3.32




# PERMANENT SEEDING

PS

## Definition

The establishment of perennial vegetative cover on disturbed areas by planting seed.

## Purposes

1. To reduce erosion and decrease sediment yield from disturbed areas.
2. To permanently stabilize disturbed areas in a manner that is economical, adaptable to site conditions, and allows selection of the most appropriate plant materials.
3. To improve wildlife habitat.
4. To enhance natural beauty.

## Conditions Where Practice Applies

1. Disturbed areas where permanent, long-lived vegetative cover is needed to stabilize the soil.

2. Rough-graded areas which will not be brought to final grade for a year or more.

## Planning Considerations

Vegetation controls erosion by reducing the velocity and the volume of overland flow and protecting the bare soil surface from raindrop impact.

Areas which must be stabilized after the land has been disturbed require vegetative cover. The most common and economical means of establishing this cover is by seeding grasses and legumes. Permanent vegetative covers must meet the requirements of Minimum Standard #3.

Advantages of seeding over other means of establishing plants include the small initial establishment cost, the wide variety of grasses and legumes available, low labor requirement, and ease of establishment in difficult areas.

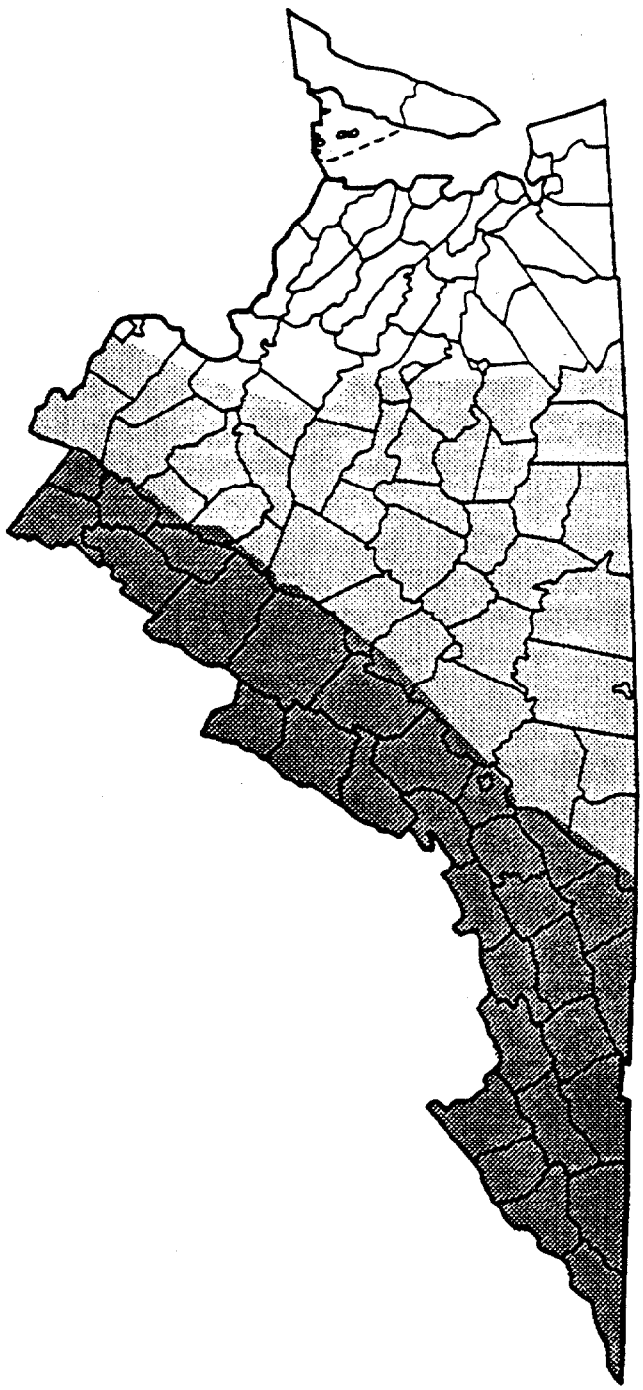
Disadvantages which must be dealt with are the potential for erosion during the establishment stage, a need to reseed areas that fail to establish, limited periods during the year suitable for seeding, the potential need for weed control during the establishment phase, and a need for water and appropriate climatic conditions during germination.

There are so many variables in plant growth that an end product cannot be guaranteed. Much can be done in the planning stages to increase the chances for successful seeding. Selection of the right plant materials for the site, good seedbed preparation, and conscientious maintenance are important.

SELECTING PLANT MATERIALS: The factors affecting plant growth are climate, soils, and topography. In Virginia, there are three major physiographic regions that reflect changes in soil and topography. In selecting appropriate plant materials, one should take into account the characteristics of the physiographic region in which the project is located (see Plate 3.32-1).

PHYSIOGRAPHIC REGIONS:

Coastal Plain - Soils on the Coastal Plain are deeply weathered, stratified deposits of sand and clay. They are generally acidic and low in plant nutrients. The sandy soils are hot and droughty in summer. This region receives more rain and is warmer than the other regions of the state. The land is fairly level, and many areas are poorly drained. Warm season grasses traditionally perform well in these areas.




PHYSIOGRAPHIC PROVINCES IN VIRGINIA

Source: Va. DSWC

Plate 3.32-1

Piedmont - Soils on the Piedmont plateau are highly variable. They tend to be shallow, with clayey subsoils. Piedmont soils are low in phosphorus. Soils derived from mica schist are highly erodible. Topography is rolling and hilly. The southern Piedmont has much the same climate as the Coastal Plain. Often referred to as the "transition zone" in planting. Contains areas that will support both warm or cool season grasses.

Appalachian and Blue Ridge Region - This region is divided into plateaus, mountains, and narrow valleys. Soils tend to be shallow and acid, and may erode rapidly on steep slopes. Shaley slopes are often unstable and droughty. This area is colder and drier than the rest of the State. The rugged topography makes plant establishment difficult. Cool season grasses are normally specified in this region.

SOILS: On the whole, soils in Virginia always require some nitrogen (N) fertilization to establish plants. Phosphorus (P) and potassium (K) are usually needed. Except for some small pockets of shallow limestone soils, lime is universally needed.

Soils can be modified with lime and fertilizer, but climate cannot be controlled. For this reason, the State has been divided into two major climatic regions, referred to as the Northern Piedmont and Mountain Region and the Southern Piedmont and Coastal Plain Region, for grass and legume selection (see map, Plate 3.32-2).

Microclimate, or localized climate conditions, can affect plant growth. A south-facing slope is drier and hotter than a north-facing slope, and may require drought-tolerant plants. Shaded areas require shade-tolerant plants; the windward side of a ridge will be drier than the leeward, etc.

LAND USE: A prime consideration in selecting which plants to establish is the intended use of the land. All of these uses - residential, industrial, commercial, recreational - can be separated into two major categories: high-maintenance and low-maintenance.

High-maintenance areas will be mowed frequently, limed and fertilized regularly, and will either receive intense use (e.g., athletics) or require maintaining to an aesthetic standard (home lawns). Grasses used for these situations must be fine-leaved and attractive in appearance, able to form tight sod, and be long-lived perennials. They must be well-adapted to the geographic area where they are planted, because constant mowing puts turf under great stress. Sites where high-maintenance vegetative cover is desirable include homes, industrial parks, schools, churches, athletic playing surfaces as well as some recreational areas.

Low-maintenance areas will be mowed infrequently or not at all; lime and fertilizer may not be applied on a regular basis; the areas will not be subjected to intense use, nor required to have a uniform appearance. These plants must be able to persist with little maintenance over long periods of time. Grass and legume mixtures are favored for these sites because legumes are capable of fixing nitrogen from the air for their own use, and the use of the plants around them. Such mixed stands are better able to withstand adverse conditions.

Sites that would be suitable for low-maintenance vegetation include steep slopes, stream or channel banks, some commercial properties, and "utility turf" areas such as roadbanks.

Seedbed Preparation - The soil on a disturbed site must be modified to provide an optimum environment for seed germination and seedling growth. The surface soil must be loose enough for water infiltration and root penetration. The pH (acidity and alkalinity) of the soil must be such that it is not toxic and nutrients are available, usually between pH 6.0-7.0. Sufficient nutrients (added as fertilizer) must be present. After seed is in place, it must be protected with a mulch to hold moisture and modify temperature extremes, and to prevent erosion while seedlings are growing.

The addition of lime is equally as important as applying fertilizer. Lime is best known as a pH, or acidity, modifier, but it also supplies calcium and magnesium which are plant nutrients. Its effect on pH makes other nutrients more available to the plant. It can also prevent aluminum toxicity by making aluminum less soluble in the soil. Many soils in Virginia are high in aluminum, which stunts the growth of plant roots.

MAINTENANCE: Even with careful, well-planned seeding operations, failures can occur. When it is clear that plants have not germinated on an area or have died, these areas must be reseeded immediately to prevent erosion damage. However, it is extremely important to determine for what reason germination did not take place and make any corrective action necessary prior to reseeding the area. Healthy vegetation is the most effective erosion control available.

## Specifications

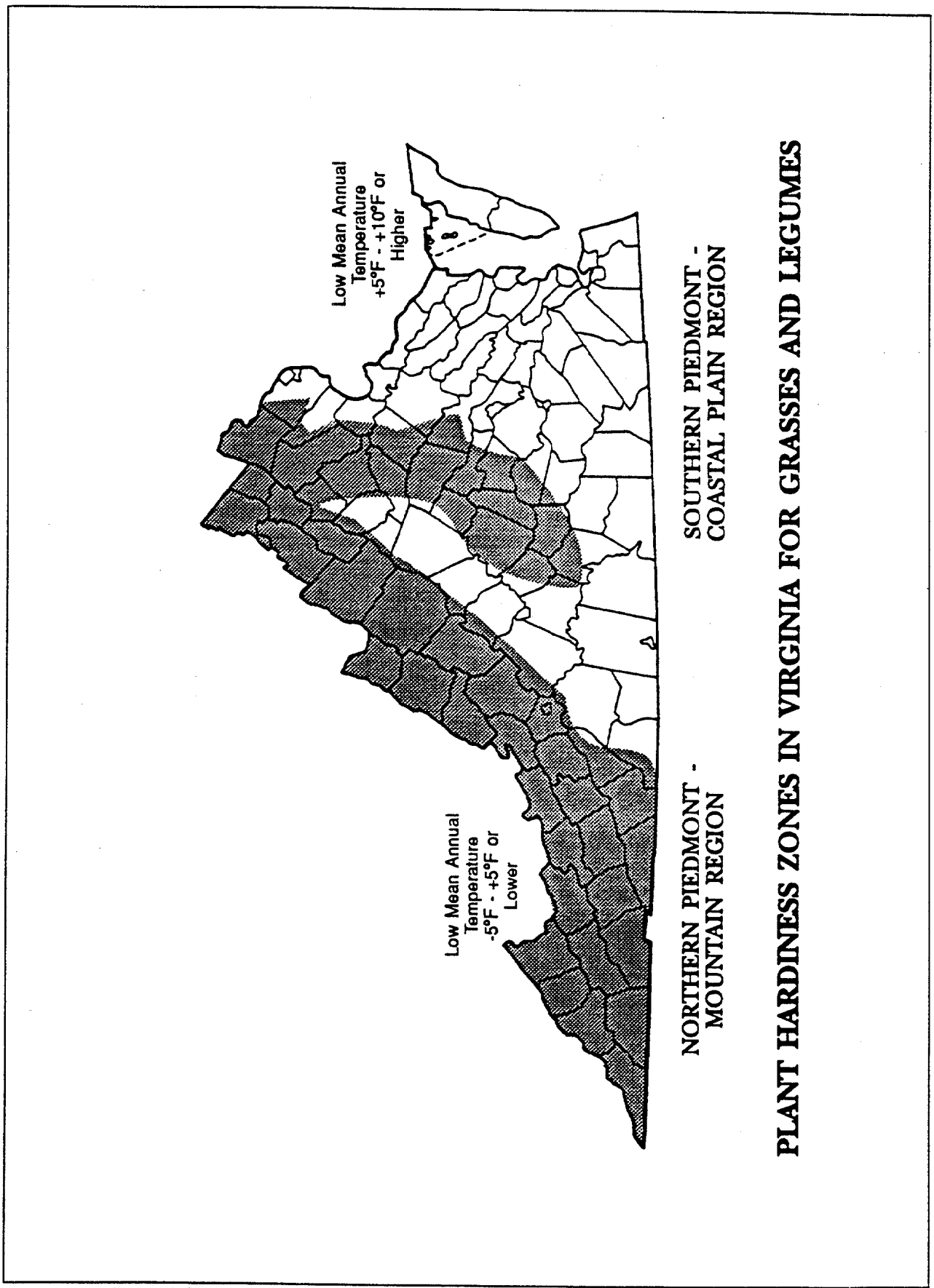
### Selection of Plant Materials

1. Selection of plant materials is based on climate, topography, soils, land use, and planting season. To determine which plant materials are best adapted to a specific site, use Tables 3.32-A and 3.22-B which describe plant characteristics and list recommended varieties.

2. Appropriate seeding mixtures for various site conditions in Virginia are given in Tables 3.32-C, 3.32-D and 3.32-E. These mixtures are designed for general use, and are known to perform well on the sites described. Check Tables 3.32-A and 3.32-B for recommended varieties.

3. A more extensive description of plant materials (grasses and legumes), their usage and pictorial representation can be found in Appendix 3.32-c.

4. When using some varieties of turfgrasses, the Virginia Crop Improvement Association (VCIA) recommended turfgrass mixtures may also be used. Consumer protection programs have been devised to identify quality seed of the varieties recommended by the Virginia Cooperative Extension Service. These will bear a label indicating




Source: Adapted from Virginia Climate Advisory, 1979. Plate 3.32-2

that they are approved by the Association. Mixtures may be designed for a specific physiographic region or based on intended use. Special consideration is given to plant characteristics, performance, etc.

**TABLE 3.32-A**
**CHARACTERISTICS OF COMMONLY SELECTED GRASSES**

| COMMON NAME (Botanical Name) | Life Cycle | Season | pH Range | Germination Time In Days | Optimum Germination Temperature (°F) | Winter Hardiness | Drought Tolerance | Fertility | Soil Drainage Tolerance | Seeds Per Pound | MAINTENANCE REQUIREMENTS | REMARKS | Suggested Varieties for Virginia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TALL FESCUE (Festuca arundinacea) | P | C | 5.5-6.2 | 10-14 | 60-85 | F | F | M | SPD | 225K | Low when used for erosion control; high when used in lawn | Better suited for erosion control and rough turf application. | Ky 31 |
| TALL FESCUES (Improved) | P | C | 5.5-6.2 | 10-14 | 60-85 | F | G | M | SPD | 220K | Responds well to high maintenance. | Excellent for lawn and fine turf. | See current VCIA list. |
| KENTUCKY BLUEGRASS (Poa pratense) | P | C | 6.0-6.5 | 14 | 60-75 | G | P | M | SPD | 2.2m | Needs fertile soil, favorable moisture. Requires several years to become well established. | Excellent for fine turfs-takes traffic, mowing. Poor drought/heat tolerance. | See current VCIA list. |
| PERENNIAL RYEGRASS (Lolium perenne) | P | C | 5.8-6.2 | 7-10 | 60-75 | F | F | M-H | SPD | 227K | Will tolerate traffic. | May be added to mixes. * Improved varieties will perform well all year. | See current VCIA list. |

**KEY**

A = Annual P = Perennial C = Cool Season Plant W = Warm Season Plant G = Good F = Fair P = Poor VP = Very Poor H = High
M = Medium L = Low SPD = Somewhat Poorly Drained MPD = Moderately Poorly Drained PD = Poorly Drained VPD = Very Poorly Drained

**TABLE 3.32-A (Continued)**
**CHARACTERISTICS OF COMMONLY SELECTED GRASSES**

| COMMON NAME (Botanical Name) | | Life Cycle | Season | pH Range | Germination Time, In Days | Optimum Germination Temperature (°F) | Winter Hardiness | Drought Tolerance | Fertility | Soil Drainage Tolerance | Seeds Per Pound | MAINTENANCE REQUIREMENTS | REMARKS | Suggested Varieties for Virginia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **FINE FESCUES** | HARD FESCUE (Festuca Longifolia) | P | C | 5.0-6.2 | 10-14 | 60-80 | VG | G | L | MWD | 400K | Grows well in sun or shade and will tolerate infertile soils; improved disease resistance. | Exceeds all fine fescues in most tests. Excellent for low-maintenance situations. | Reliant, Spartan, Aurora |
| | CHEWINGS FESCUE | P | C | 5.0-6.2 | 10-14 | 60-80 | VG | G | L | MWD | 400K | Tolerates shade, dry infertile soils. | Poor traffic tolerance, less thatch than other fine fescues. | Flyer |
| | RED FESCUE (Festuca Rubra) | P | C | 5.0-6.2 | 10-14 | 60-80 | VG | G | L | MWD | 400K | Low to medium fertility requirements. Requires well-drained soil. | Spreads by rhizomes, tillers and stolons. Will not take traffic - very shade tolerant. | Long-fellow, Victory |
| REED CANARYGRASS (Phalaris arundinacea) | | P | C | 5.8-6.2 | 21 | 70-85 | G | G | M-H | VPD | 530K | Do not mow closely or often. | Conservation cover in wet areas. | No named varieties |

**KEY**

A = Annual P = Perennial C = Cool Season Plant W = Warm Season Plant G = Good F = Fair P = Poor VP = Very Poor H = High
M = Medium L = Low SPD = Somewhat Poorly Drained MPD = Moderately Poorly Drained PD = Poorly Drained VPD = Very Poorly Drained

**TABLE 3.32-A (Continued)**
**CHARACTERISTICS OF COMMONLY SELECTED GRASSES**

| COMMON NAME (Botanical Name) | Life Cycle | Season | pH Range | Germination Time, In Days | Optimum Germination Temperature (°F) | Winter Hardiness | Drought Tolerance | Fertility | Soil Drainage Tolerance | Seeds Per Pound | MAINTENANCE REQUIREMENTS | REMARKS | Suggested Varieties for Virginia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| REDTOP (Agrostis alba) | P | C | 5.8-6.2 | 10 | 65-85 | G | F | L | PD | 5m | Will tolerate poor, infertile soils; deep rooted. | Does well in erosion control mixes - not for lawns. | No named varieties. |
| WEEPING LOVEGRASS (Evagrostis curvula) | P | W | 4.5-6.2 | 14 | 65-85 | F-P | G | L-M | SPD | 1.5m | Low-fertility requirements; excellent drought tolerance. | Fast-growing, warm-season bunch grass. Excellent cover for erosion control. | No named varieties. |
| BERMUDAGRASS (Cynodon dactylon) | P | W | 5.8-6.2 | 21 | 70-95 | P | G | M-H | SPD | 1.8m hulled | High nitrogen utilization, excellent drought tolerance. Some varieties adapted to western VA. | Common varieties used for erosion control. Hybrids used for fine turf. | See current VCIA list. |
| ORCHARDGRASS (Dactylis glomerata) | P | C | 5.8-6.2 | 18 | 60-75 | F | F | M | SPD | 625K | Does best on well-drained, loamy soil. | Good pasture selection - may be grazed. | Virginia origin or Potomac |

**KEY**

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M = Medium L = Low SPD = Somewhat Poorly Drained MPD = Moderately Poorly Drained PD = Poorly Drained VPD = Very Poorly Drained

**TABLE 3.32-A (Continued)**
**CHARACTERISTICS OF COMMONLY SELECTED GRASSES**

| COMMON NAME (Botanical Name) | Life Cycle | Season | pH Range | Germination Time In Days | Optimum Germination Temperature (°F) | Winter Hardiness | Drought Tolerance | Fertility | Soil Drainage Tolerance | Seeds Per Pound | MAINTENANCE REQUIREMENTS | REMARKS | Suggested Varieties for Virginia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ANNUAL RYEGRASS (Lolium multiflorum) | A | C | 5.8-6.2 | 7 | 60-70 | G | P | M-H | SPD | 227K | Will grow on most Virginia Soils. Do not use in fine-turf areas. | May be added into mixes or established alone as temporary cover in spring and fall. | No named varieties. |
| RYE (Secale cereale) | A | C | 5.8-6.2 | 7 | 55-70 | VG | G | L-M | SPD | 18K | Will establish in most all Virginia soils. Do not use in fine-turf areas. | May be added into mixes or established alone for late fall/winter cover. | Abruzzi, Balboa |
| FOXTAIL MILLET (Setaria italica) | A | W | 5.8-6.2 | 10 | 65-85 | VP | G | M | MWD | 220K | Establishes well during summer. Very low moisture requirements. | May be added to erosion-control mixes or established alone. | Common, German |

**KEY**

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M = Medium L = Low SPD = Somewhat Poorly Drained MPD = Moderately Poorly Drained PD = Poorly Drained VPD = Very Poorly Drained

## TABLE 3.32-B
## CHARACTERISTICS OF LEGUMES APPROPRIATE FOR EROSION CONTROL

| COMMON NAME (Botanical Name) | Life Cycle | Season | pH Range | Germination Time In Days | Optimum Germination Temperature (°F) | Winter Hardiness | Drought Tolerance | Fertility | Soil Drainage Tolerance | Seeds Per Pound | MAINTENANCE REQUIREMENTS | REMARKS | Suggested Varieties for Virginia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CROWNVETCH (Coronilla varia) | P | C | 6.0-6.5 | 14-21 | 70 | G | VG | M | MWD | 110K | Does best on well-drained soils. Minimum maintenance when established. May need phosphorus. Inoculation is essential. | Excellent for steep, rocky slopes. Produces colorful blooms in May/June. Slow to establish. Does best when seeded in spring. | Penngift Chemung Emerald |
| SERICEA LESPEDEZA (Lespedeza cuneata) | P | W | 5.8-6.2 | 21-28 | 70-85 | F | VG | L | MWD | 335K | Grows in most well-drained soils. Low fertility requirements. Inoculation is essential. | Use hulled seed in spring; unhulled in fall. Very deep-rooted legume. Excellent choice for eastern Va. | Serecia Interstate |
| FLATPEA (Lathyrus silvestrus) | P | C | 5.0-7.0 | 14-28 | 65-75 | G | G | L | PD | 15K | Needs lime and high phosphorus. Good shade tolerance. | Tolerates acidic and wetter soils better than other legumes. | Lathco |
| BIRDSFOOT TREFOIL (Lotus corniculatus) | P | C | 6.0-6.5 | 7 | 65-70 | G | F | M | SPD | 375K | Inoculation is essential. Grows in medium-fertile, slightly acid soils. | Grows better on poorly drained soils than most legumes. Poor drought/heat tolerance. | No named varieties. |

**KEY**

A = Annual P = Perennial C = Cool Season Plant W = Warm Season Plant G = Good F = Fair P = Poor VP = Very Poor H = High
M = Medium L = Low SPD = Somewhat Poorly Drained MPD = Moderately Poorly Drained PD = Poorly Drained VPD = Very Poorly Drained

**TABLE 3.32-B (Continued)**
**CHARACTERISTICS OF LEGUMES APPROPRIATE FOR EROSION CONTROL**

| COMMON NAME (Botanical Name) | Life Cycle | Season | pH Range | Germination Time In Days | Optimum Germination Temperature (°F) | Winter Hardiness | Drought Tolerance | Fertility | Soil Drainage Tolerance | Seeds Per Pound | MAINTENANCE REQUIREMENTS | REMARKS | Suggested Varieties for Virginia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ANNUAL LESPEDEZAS (Lespedeza striata, L. stipulacea) | A | W | 5.8-6.2 | 14 | 70-85 | F | VG | L | MWD | 200K | Will grow on almost any well-drained soil. | Choose Kobe for southeastern Va.; needs almost no nitrogen to survive. | Kobe, Korean |
| RED CLOVER (Trifolium pratense) | P | C | 6.0-6.5 | 7-14 | 70 | G | F | M | SPD | 275K | Needs high levels of phosphorus and potassium. | Acts as a biennial. Can be added to low-maintenance mixes. | Kenstar, Kenland |
| WHITE CLOVER (Trifolium repens) | P | C | 6.0-6.5 | 10 | 70 | G | P | M | PD | 700K | Requires favorable moisture, fertile soils, high pH. | Spreads by soil surface stolons, white flowers. | Common, White Dutch |

**KEY**

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M = Medium L = Low SPD = Somewhat Poorly Drained MPD = Moderately Poorly Drained PD = Poorly Drained VPD = Very Poorly Drained

## TABLE 3.32-C
## SITE SPECIFIC SEEDING MIXTURES
## FOR APPALACHIAN/MOUNTAIN AREA

| | Total Lbs. Per Acre |
|---|---|
| Minimum Care Lawn | |
| - Commercial or Residential | 200-250 lbs. |
| - Kentucky 31 or Turf-Type Tall Fescue | 90-100% |
| - Improved Perennial Ryegrass * | 0-10% |
| - Kentucky Bluegrass | 0-10% |
| High-Maintenance Lawn | |
| Minimum of three (3) up to five (5) varieties of bluegrass from approved list for use in Virginia. | 125 lbs. |
| General Slope (3:1 or less) | |
| - Kentucky 31 Fescue | 128 lbs. |
| - Red Top Grass | 2 lbs. |
| - Seasonal Nurse Crop ** | 20 lbs. |
| | 150 lbs. |
| Low-Maintenance Slope (Steeper than 3:1) | |
| - Kentucky 31 Fescue | 108 lbs. |
| - Red Top Grass | 2 lbs. |
| - Seasonal Nurse Crop ** | 20 lbs. |
| - Crownvetch *** | 20 lbs. |
| | 150 lbs. |

* Perennial Ryegrass will germinate faster and at lower soil temperatures than fescue, thereby providing cover and erosion resistance for seedbed.

** Use seasonal nurse crop in accordance with seeding dates as stated below:

| | |
|---|---|
| March, April through May 15th | Annual Rye |
| May 16th through August 15th | Foxtail Millet |
| August 16th through September, October | Annual Rye |
| November through February | Winter Rye |

*** If Flatpea is used, increase to 30 lbs./acre. All legume seed must be properly inoculated. Weeping Lovegrass may also be included in any slope or low-maintenance mixture during warmer seeding periods; add 10-20 lbs/acre in mixes.

**TABLE 3.32-D**
**SITE SPECIFIC SEEDING MIXTURES FOR PIEDMONT AREA**

| | Total Lbs. Per Acre |
|---|---|
| Minimum Care Lawn | |
| - Commercial or Residential | 175-200 lbs. |
| - Kentucky 31 or Turf-Type Tall Fescue | 95-100% |
| - Improved Perennial Ryegrass | 0-5% |
| - Kentucky Bluegrass | 0-5% |
| High-Maintenance Lawn | 200-250 lbs. |
| - Kentucky 31 or Turf-Type Tall Fescue | 100% |
| General Slope (3:1 or less) | |
| - Kentucky 31 Fescue | 128 lbs. |
| - Red Top Grass | 2 lbs. |
| - Seasonal Nurse Crop * | 20 lbs. |
| | 150 lbs. |
| Low-Maintenance Slope (Steeper than 3:1) | |
| - Kentucky 31 Fescue | 108 lbs. |
| - Red Top Grass | 2 lbs. |
| - Seasonal Nurse Crop * | 20 lbs. |
| - Crownvetch ** | 20 lbs. |
| | 150 lbs. |

* Use seasonal nurse crop in accordance with seeding dates as stated below:
February 16th through April ..... Annual Rye
May 1st through August 15th ..... Foxtail Millet
August 16th through October ..... Annual Rye
November through February 15th ..... Winter Rye

** Substitute Sericea lespedeza for Crownvetch east of Farmville, Va. (May through September use hulled Sericea, all other periods, use unhulled Sericea). If Flatpea is used in lieu of Crownvetch, increase rate to 30 lbs./acre. All legume seed must be properly inoculated. Weeping Lovegrass may be added to any slope or low-maintenance mix during warmer seeding periods; add 10-20 lbs./acre in mixes.

## TABLE 3.32-D

## SITE SPECIFIC SEEDING MIXTURES FOR COASTAL PLAIN AREA

| | Total Lbs. Per Acre |
|---|---|
| Minimum Care Lawn | |
| - Commercial or Residential | |
| - Kentucky 31 or Turf-Type Tall Fescue | 175-200 lbs. |
| **or** | |
| - Common Bermudagrass ** | 75 lbs. |
| High-Maintenance Lawn | |
| - Kentucky 31 or Turf-Type Tall Fescue | 200-250 lbs. |
| **or** | |
| - Hybrid Bermudagrass (seed) ** | 40 lbs. (unhulled) 30 lbs. (hulled) |
| **or** | |
| - Hybrid Bermudagrass (by other vegetative establishment method, see Std. & Spec. 3.34) | |
| General Slope (3:1 or less) | |
| - Kentucky 31 Fescue | 128 lbs. |
| - Red Top Grass | 2 lbs. |
| - Seasonal Nurse Crop * | 20 lbs. |
| | 150 lbs. |
| Low Maintenance Slope (Steeper than 3:1) | |
| - Kentucky 31 Tall Fescue | 93-108 lbs. |
| - Common Bermudagrass ** | 0-15 lbs. |
| - Red Top Grass | 2 lbs. |
| - Seasonal Nurse Crop * | 20 lbs. |
| - Sericea Lespedeza ** | 20 lbs. |
| | 150 lbs. |

* Use seasonal nurse crop in accordance with seeding dates as stated below:

| | |
|---|---|
| February, March through April | Annual Rye |
| May 1st through August | Foxtail Millet |
| September, October through November 15th | Annual Rye |
| November 16th through January | Winter Rye |

** May through October, use hulled seed. All other seeding periods, use unhulled seed. Weeping Lovegrass may be added to any slope or low-maintenance mix during warmer seeding periods; add 10-20 lbs./acre in mixes.

Seedbed Requirements

Vegetation should not be established on slopes that are unsuitable due to inappropriate soil texture, poor internal structure or internal drainage, volume of overland flow, or excessive steepness, until measures have been taken to correct these problems.

To maintain a good stand of vegetation, the soil must meet certain minimum requirements as a growth medium. The existing soil must have these characteristics:

1. Enough fine-grained material to maintain adequate moisture and nutrient supply.

2. Sufficient pore space to permit root penetration. A bulk density of 1.2 to 1.5 indicates that sufficient pore space is present. A fine granular or crumb-like structure is also favorable.

3. Sufficient depth of soil to provide an adequate root zone. The depth to rock or impermeable layers such as hardpans shall be 12 inches or more, except on slopes steeper than 2:1 where the addition of soil is not feasible.

4. A favorable pH range for plant growth. If the soil is so acidic that a pH range of 6.0-7.0 cannot be attained by addition of pH-modifying materials, then the soil is considered an unsuitable environment for plant roots and further soil modification would be required.

5. Freedom from toxic amounts of materials harmful to plant growth.

6. Freedom from excessive quantities of roots, branches, large stones, large clods of earth, or trash of any kind. Clods and stones may be left on slopes steeper than 3:1 if they do not significantly impede good seed soil contact.

If any of the above criteria cannot be met, i.e., if the existing soil is too coarse, dense, shallow, acidic, or contaminated to foster vegetation, then topsoil shall be applied in accordance with TOPSOILING, Std. & Spec. 3.30.

Necessary structural erosion and sediment control practices will be installed prior to seeding. Grading will be carried out according to the approved plan.

Surfaces will be roughened in accordance with SURFACE ROUGHENING, Std. & Spec. 3.29.

Soil Conditioners

In order to modify the texture, structure, or drainage characteristics of a soil, the following materials may be added to the soil:

1. Peat is a very costly conditioner, but works well. If added, it shall be sphagnum moss peat, hypnum moss peat, reed-sedge peat or peat humus, from fresh-water sources. Peat shall be shredded and conditioned in storage piles for at least six months after excavation.

2. Sand shall be clean and free of toxic materials. Sand modification is ineffective unless you are adding 80 to 90% sand on a volume basis. This is extremely difficult to do on-site. If this practice is considered, consult a professional authority to ensure that it is done properly.

3. Vermiculite shall be horticultural grade and free of toxic substances. It is an impractical modifier for larger acreage due to expense.

4. Raw manure is more commonly used in agricultural applications. However, when stored properly and allowed to compost, it will stabilize nitrogen and other nutrients. Manure, in its composted form, is a viable soil conditioner; however, its use should be based on site-specific recommendations offered by a professional in this field.

5. Thoroughly rotted sawdust shall have 6 pounds of nitrogen added to each cubic yard and shall be free of stones, sticks, and toxic substances.

6. The use of treated sewage sludge has benefitted from continuing advancements in its applications in the agricultural community. When composted, it offers an alternative soil amendment. Limitations include a potentially undesirable pH (because of lime added during the treatment process) and the possible presence of heavy metals. This practice should be thoroughly evaluated by a professional and be used in accordance with any local, state, and federal regulations.

Lime and Fertilizer

Lime and fertilizer needs should be determined by soil tests. Soil tests may be performed by the Cooperative Extension Service Soil Testing Laboratory at VPI&SU, or by a reputable commercial laboratory. Information concerning the State Soil Testing Laboratory is available from county extension agents. Reference Appendix 3.32-d for liming applications (in lbs.) needed to correct undesirable pH for various soil types.

Under unusual conditions where it is not possible to obtain a soil test, the following soil amendments will be applied:

Lime

Coastal Plain: 2 tons/acre pulverized agricultural grade limestone (90 lbs./1000 ft.$^2$).

Piedmont and Appalachian Region: 2 tons/acre pulverized agricultural grade limestone (90 lbs./1000 ft.$^2$).

**Note:** An agricultural grade of limestone should always be used.

Fertilizer

Mixed grasses and legumes: 1000 lbs./acre 10-20-10 or equivalent nutrients (23 lbs./1000 ft.$^2$).

Legume stands only: 1000 lbs./acre 5-20-10 (23 lbs./ 1000 ft.$^2$) is preferred; however, 1000 lbs./acre of 10-20-10 or equivalent may be used.

Grass stands only: 1000 lbs./acre 10-20-10 or equivalent nutrients, (23 lbs./1000 ft.$^2$).

Other fertilizer formulations, including slow-release sources of nitrogen (preferred from a water quality standpoint), may be used provided they can supply the same amounts and proportions of plant nutrients.

Incorporation - Lime and fertilizer shall be incorporated into the top 4-6 inches of the soil by discing or other means whenever possible. For erosion control, when applying lime and fertilizer with a hydroseeder, apply to a rough, loose surface.

Seeding

1. Certified seed will be used for all permanent seeding whenever possible. Certified seed is inspected by the Virginia Crop Improvement Association or the certifying agency in other states. The seed must meet published state standards and bear an official "Certified Seed" label (see Appendix 3.32-a).


2. Legume seed should be inoculated with the inoculant appropriate to the species. Seed of the Lespedezas, the Clovers and Crownvetch should be scarified to promote uniform germination.

3. Apply seed uniformly with a broadcast seeder, drill, culti-packer seeder, or hydroseeder on a firm, friable seedbed. Seeding depth should be 1/4 to 1/2 inch.

4. To avoid poor germination rates as a result of seed damage during hydroseeding, it is recommended that if a machinery breakdown of 30 minutes to 2 hours occurs, 50% more seed be added to the tank, based on the proportion of the slurry remaining in the tank. Beyond 2 hours, a full rate of new seed may be necessary.

Often hydroseeding contractors prefer not to apply lime in their rigs as it is abrasive. In inaccessible areas, lime may have to be applied separately in pelletized or liquid form. Surface roughening is particularly important when hydroseeding, as a roughened slope will provide some natural coverage of lime, fertilizer and seed.

Legume inoculants should be applied at five times the recommended rate when inoculant is included in the hydroseeder slurry.

Mulching

All permanent seeding must be mulched immediately upon completion of seed application. Refer to MULCHING, Std. & Spec. 3.35.

Maintenance of New Seedings

In general, a stand of vegetation cannot be determined to be fully established until it has been maintained for one full year after planting.

Irrigation: New seedings should be supplied with adequate moisture. Supply water as needed, especially late in the season, in abnormally hot or dry weather, or on adverse sites. Water application rates should be controlled to prevent excessive runoff. Inadequate amounts of water may be more harmful than no water.

Re-seeding: Inspect seeded areas for failure and make necessary repairs and re-seedings within the same season, if possible.

a. If vegetative cover is inadequate to prevent rill erosion, over-seed and fertilize in accordance with soil test results.

b. If a stand has less than 40% cover, re-evaluate choice of plant materials and quantities of lime and fertilizer. The soil must be tested to determine if acidity or nutrient imbalances are responsible. Re-establish the stand following seedbed preparation and seeding recommendations.

Fertilization: Cool season grasses should begin to be fertilized 90 days after planting to ensure proper stand and density. Warm season fertilization should begin at 30 days after planting.

Apply maintenance levels of fertilizer as determined by soil test. In the absence of a soil test, fertilization should be as follows:

Cool Season Grasses

4 lbs. nitrogen (N)

1 lb. phosphorus (P) } Per 1000 ft.$^2$ per year

2 lbs. potash (K)

Seventy-five percent of the total requirements should be applied between September 1 and December 31st. The balance should be applied during the remainder of the year. **More than 1 lb. of soluble nitrogen per 1000 ft.$^2$ should not be applied at any one time.**

Warm Season Grasses

Apply 4-5 lbs. nitrogen (N) between May 1 and August 15th per 1000 ft.$^2$ per year.

Phosphorus (P) and Potash (K) should only be applied according to soil test.

**Note:** The use of slow-release fertilizer formulations for maintenance of turf is encouraged to reduce the number of applications and the impact on groundwater.

Additional Information on the Successful Establishment of Grasses and Legumes

See Appendix 3.32-b for "helpful hints" in achieving high success rates in grass or legume plantings.

## APPENDIX 3.32-a

## SEED QUALITY CRITERIA

Where certified seed is not available, the minimum requirements for grass and legume seed used in vegetative establishment are as follows:

a. All tags on containers of seed shall be labeled to meet the requirements of the State Seed Law.

b. All seed shall be subject to re-testing by a recognized seed laboratory that employs a registered seed technologist or by a state seed lab.

c. All seed used shall have been tested within twelve (12) months.

d. Inoculant - the inoculant added to legume seed in the seed mixtures shall be a pure culture of nitrogen-fixing bacteria prepared for the species. Inoculants shall not be used later than the date indicated on the container. Twice the supplier's recommended rate of inoculant will be used on dry seedings; five times the recommended rate if hydroseeded.

e. The quality of the seed used shall be shown on the bag tags to conform to the guidelines in Table 3.32-E.

## TABLE 3.32-E

## QUALITY OF SEED*

| | Minimum Seed Purity (%) | Minimum Germination (%) |
|---|---|---|
| Legumes | | |
| Crownvetch | 98 | 65** |
| Lespedeza, Korean | 97 | 85** |
| Lespedeza, Sericea | 98 | 85** |
| Grasses | | |
| Bluegrass, Kentucky | 97 | 85 |
| Fescue, Tall (Improved, Turf-Type Cultivars) | 98 | 85 |
| Fescue, Tall (Ky-31) | 97 | 85 |
| Fescue, Red | 98 | 85 |
| Redtop | 94 | 80 |
| Reed Canarygrass | 98 | 80 |
| Perennial Ryegrass | 98 | 90 |
| Weeping Lovegrass | 98 | 87 |
| Annuals | | |
| Annual Ryegrass | 97 | 90 |
| German Millet | 98 | 85 |
| Oats | 98 | 80 |
| Cereal Rye | 98 | 85 |

* Seed containing prohibited or restricted noxious weeds should not be accepted. Seed should not contain in excess of 0.5% weed seed. To calculate percent pure, live seed, multiply germination times purity and divide by 100.

Example: Ky-31 Tall Fescue with a germination of 85 percent and a purity of 97 percent.

97 x 85 = 8245. 8245 ÷ 100 = 82.45 percent pure live seed.

** Includes "hard seed"

## APPENDIX 3.32-b

## KEYS TO SUCCESSFUL ESTABLISHMENT OF GRASSES AND LEGUMES

Planning

Where feasible, grading operations should be planned around optimal seeding dates for the particular region. The most effective times for establishing perennial grass in Virginia generally extend from March through May and from August through October. Outside these dates, the probability of failure is much higher. If the time of year is not suitable for seeding a permanent cover (perennial species), a temporary cover crop should be planted. Temporary seeding of annual species (small grains, ryegrasses or millets) often succeeds during periods of the year that are unsuitable for seeding permanent (perennial) species.

Variations in weather and local site conditions can modify the effects of regional climate on seeding success. For this reason, mixtures including both cool and warm season species are preferred for low-maintenance cover, particularly in the Coastal Plain. Such mixtures promote cover which can adapt to a range of conditions. Many of these mixtures are not desirable, however, for high quality lawns, where variation in texture of the turf is inappropriate. It is important to note that in Virginia the establishment of 100% warm season grasses in a high quality lawn is limited to the extreme eastern portions of the Coastal Plain.

Selection

Species selection should be considered early in the process of preparing an erosion and sediment control plan. A variety of vegetation can be established in Virginia due to the diversity in both soils and climate. However, for practical, economical stabilization and long-term protection of disturbed sites, species selection should be made judiciously.

Seasonality must be considered when selecting species. Grasses and legumes are usually classified as warm or cool season in reference to their season of growth. Cool season plants realize most of their growth during the spring and fall and are relatively inactive or dormant during the hot summer months. Therefore, fall is the most favorable time to plant them. Warm season plants "green-up" late in the spring, grow most actively during the summer, and go dormant at the time of the first frost in fall. Spring and early summer are preferred planting times for warm season plants.

Seed Mixtures

As previously noted, the establishment of high quality turf frequently involves planting one single species. However, in seedings for erosion control purposes, the inclusion of more than one species should always be considered. Mixtures need not be excessive in poundage or seed count. The addition of a quick-growing annual provides early protection and facilitates establishment of one or two perennials in a mix. More complex mixtures might include a quick-growing annual, one or two legumes and more than one perennial grass.

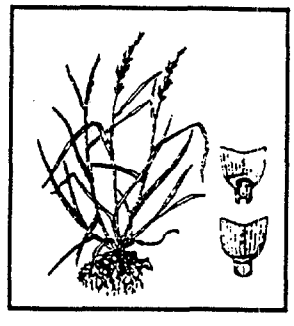
The addition of a "nurse" crop (quick-growing annuals added to permanent mixtures) is a sound practice for soil stabilization, particularly on difficult sites - those with steep slopes; poor, rocky, erosive soils; those seeded out the optimum seeding periods; or in any situation where the development of permanent cover is likely to be slow. The nurse crop germinates and grows rapidly, holding the soil until the slower-growing perennial seedlings become established.

## APPENDIX 3.32-c

## PLANT INFORMATION SHEETS

**Contents:**



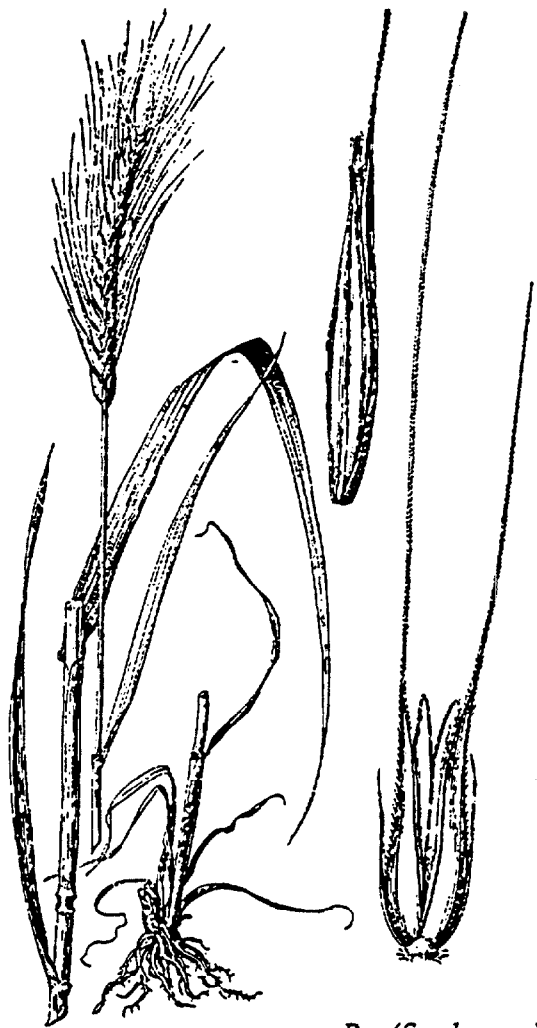


## ANNUAL GRASSES AND GRAINS

Small grains are cool season annual grasses primarily grown for animal feed and human consumption. In Virginia, the grains used for soil stabilization are primarily Rye and Oats. Foxtail Millet, which is sometimes considered a small grain, is becoming a very popular and successful planting for soil stabilization.

1. Oats (Avenasativa): A cool season annual grass primarily grown for animal feed and human consumption, but also used for soil stabilization. Oats are seeded in early spring in the western part of the state (winter oats may be sown in the Coastal Plain). Seeding rates are 3 bushels (100 lbs.) per acre bare ground or 2-1/2 lbs. per 1000 square feet.

2. Rye (Secale cereale): Often referred to as Winter Rye because of its winter hardiness, Rye is the most common small grain used for soil stabilization. It is also the most productive grain on dry, infertile, acid or sandy soils. It may be seeded in the fall for winter ground cover. By maturing early, it offers less competition during the late spring period, a critical time in the establishment of perennial species. Rye grain germinates quickly and is tolerant of poor soils. Including Rye grain in fall-seeded mixtures is almost always advantageous, but it is particularly helpful on difficult and erodible soils, erodible slopes or when seeding is late. Rates up to 100 lbs. for bare ground. Overly thick stands of Rye grain will suppress the growth of perennial seedlings. Approximately 50 lbs. per acre is the maximum for this purpose and, where lush growth is



*Rye (Secale cereale)*

expected, that rate should either be cut in half, or Rye grain should be totally eliminated from the mixture.

3. Foxtail Millet (Setaria italica): A warm season annual grass which may be used for temporary cover. German Millet (variety commonly used in Virginia) germinates quickly and goes to seed quickly. These features make it an excellent companion grass for summer seedlings. It dies at first frost. Seeding rates are up to 50 lbs. per acre for temporary cover. Use 10 to 20 lbs. per acre in mixes.

4. Annual Rye (Lolium multiflorum): A cool season annual grass used for temporary cover or as a nurse grass to allow for germination of permanent stands. Most commonly used in mixes for erosion control. Performs well throughout the state in neutral to slightly acid soils. Rates up to 100 lbs. per acre for temporary cover. Use 10 to 20 lbs. per acre in mixes.

*Foxtail Millet (Setaria italica)*

*Annual Rye (Lolium multiflorum)*

## ANNUAL LEGUMES

1. Annual Lespedezas (Lespedeza striata)

Uses: Pasture, hay, erosion control, soil improvement, wildlife food.

Description: Annual warm season legumes. Korean Lespedeza is larger and coarser than Common Lespedeza and grows to about 12 inches. Seed of Korean is shiny and black, while seed of Common is stippled. Kobe is the most desirable variety of Common Lespedeza.

Adaptation: Throughout Virginia. Optimum pH range is 6.0 to 6.5; will grow from 5.5 to 7.0. Will grow in soil textures ranging from sands to clays and through a wide range of fertility conditions.

Establishment: Seed should always be inoculated. May be seeded alone or mixed with grasses or small grains. Requires a firm seedbed; may be broadcast or drilled. Should be seeded in early spring at 25 to 40 lbs. per acre or one-half to 1 lb. per 1000 square feet, depending on use. (Use lower figure as half the seeding rate of any spring seeding with grass or grain.) Should not be mowed at less than three inches. Lespedeza will not make a large contribution in sod grasses like Bluegrass; they do best in open sod grasses like tall fescue.

Sources: Seed of common variety (Kobe) and Korean varieties (Climax, Harbin and Rowan) are commercially available.

Annual Lespedezas (Lespedeza striata)

## PERENNIALS

1. Tall Fescue (Festuca arundinacea)

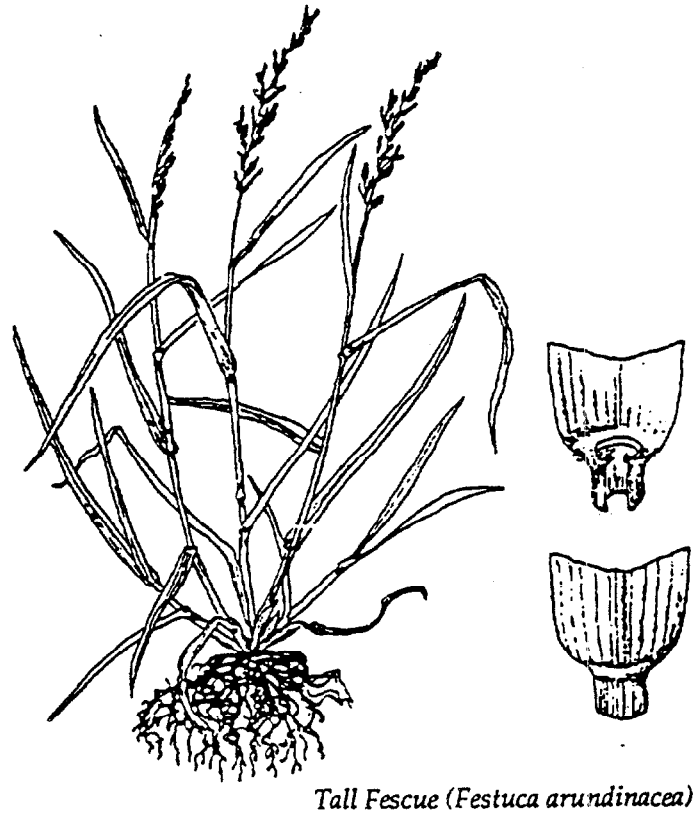
Uses: Pasture, hay, recreation areas, lawns and stabilization of waterways, banks, slopes, cuts, fills, and spoils. It is the most widely used grass at this time for stabilizing large disturbed areas.

Description: A robust, cool season, long-lived, deep-rooted bunchy grass which may have short rhizomes (underground stems). Kentucky 31 is the best-known variety. A number of new varieties of Tall Fescue are becoming available for lawn and other fine-turf uses, and several offer definite improvements. However, their higher cost over the old standby, KY 31, is seldom justified when used for purposes of stabilization and erosion control. Tall Fescue tolerates a wide range of seeding dates; however, with the possible exception of high mountain elevation, it is most dependable when planted in fall.

Adaptation: Adapts well to both high and low maintenance uses throughout Virginia. Adapted to a wide range of climatic conditions. Optimum pH range is 6.0 to 7.0; will tolerate from 3.0 to 8.0. Will grow on shallow and claypan soils if they are moist. Growth is limited more by moisture than by temperature extremes, but it will tolerate drought, infertile soils and moderate shade.

Establishment: Requires a firm seedbed. Hydroseeding is successful. Seeding rates vary from 100 lbs. per acre for erosion control to 250 lbs. per acre for lawns. Plant in early spring or from the middle of August through September. Legumes may not thrive in fescue stands due to the aggressive growth habits of this grass. Mowing is desirable on critical areas at least once every two years; lack of periodic mowing will encourage clumpiness.

Sources: Readily available as seed and sod.



*Tall Fescue (Festuca arundinacea)*

2. Kentucky Bluegrass (Poa pratense)

Uses: Pasture, turf for lawns, athletic fields, golf courses, and playgrounds. Also used to stabilize waterways, slopes, cuts and fills. Choice food for grouse, turkeys, deer and rabbits.

Description: Long-lived, cool season perennial grass which forms a dense sod. Becomes dormant in the heat of summer since its growing season is spring and fall.

Adaptation: Best adapted to well-drained, fertile soils of limestone origin and the climate of northern and western Virginia. Optimum pH range is 6.0 to 7.0. Bluegrasses are better suited to high maintenance situations in the transition zone. Essentially dormant during dry or hot weather; however, it will normally survive severe drought.

Establishment: Requires a firm, weed-free seedbed and adequate fertilization (liberal phosphorus) and lime are important. Can be used with Tall Fescues at low rates. Minimum mowing height is 1-1/2 inches. Critical erosion areas may be mowed only once per year, if desired. This grass is usually seeded with a mixture of other grasses or legumes; several varieties of Bluegrass should be used together to ensure good stand survival. Bare ground rates are 120 lbs. per acre. Overseed 1 to 1-1/2 per 1000 square feet.

*Kentucky Bluegrass (Poa pratense)*

Sources: Readily available as seed and sod.

3. Perennial Ryegrass (Lolium perrenne)

Uses: Erosion control, soil improvement, lawns, pasture, and hay; newer varieties are excellent for high-traffic areas.

Description: Perennial Ryegrasses are an excellent selection where rapid establishment is desired. Cool season. Ryegrasses cross-pollinate freely so "Common Ryegrass" may be a mixture of annual and perennial species. Certified seed of Perennial Ryegrass varieties is produced: Blaser, Palmer, Goalie, Fiesta II, Ranger, Regal and Pennfine may be used in Virginia.

Perennial Ryegrass (Lolium perrenne)

Adaptation: Throughout Virginia. Grows best on dark, rich soils in mild climates. Newer varieties have good drought tolerance but may require irrigation if under drought stress or heavy traffic. Will tolerate wet soils with good surface drainage.

Establishment: A firm, mellow surface over compact subsoils gives good results. Seed in fall or spring. Perennial Ryegrass may also be seeded in mid-August to early September. For turf, use a rate of 5 to 8 lbs. per 1000 square feet, if seeded alone; lesser amounts are suitable in mixtures, depending on the characteristics of the companion species. Generally not seeded alone except on athletic fields with intensive use. Perennial Ryegrass does best when used with bluegrass as 20 percent or less of the mixture. Ryegrasses germinate rapidly which makes them particularly suited to disturbed-area stabilization and temporary

seeding. They will, however, tend to dominate stands in mixtures if percentage is too high.

Sources: Readily available commercially. Care should be taken to buy seed appropriate to the needs of the project.

4. Fine Fescues

* Red Fescue
* Hard Fescue
* Chewings Fescue

Uses: Excellent for shady, low maintenance areas and north-facing slopes. May be used to stabilize waterways, slopes, banks, cuts, fills, and as a cover crop in orchards.

Description: Red Fescue is a cool season perennial that occurs in two forms: bunch-type and creeping. Creeping Red Fescue forms a tight sod. The leaves of Red Fescue are narrow and wiry. Hard Fescues are slow-growing with excellent shade tolerance.

Adaptation: Shade tolerant and somewhat drought-resistant once established. Grows well in sandy and acidic soils. Optimum pH range is 4.5 to 6.0. Prefers well-drained soils but requires adequate moisture for establishment. In areas of high temperature and humidity (such as southeastern Virginia), some Fine Fescues may turn brown or deteriorate during the summer. Newer varieties of Hard Fescue are more drought tolerant.

Establishment: Rarely seeded in pure stands. Seedbed preparation and fertility adjustments are usually dictated by the other grasses in the mixture. Red Fescues may comprise 25 to 60% by weight of a seeding mixture. In shaded areas red fescue may be the key grass in the mixture. Mowing consistently below 1-1/2 is not recommended.

Sources: Readily available commercially. New Hard Fescues may be in short supply.

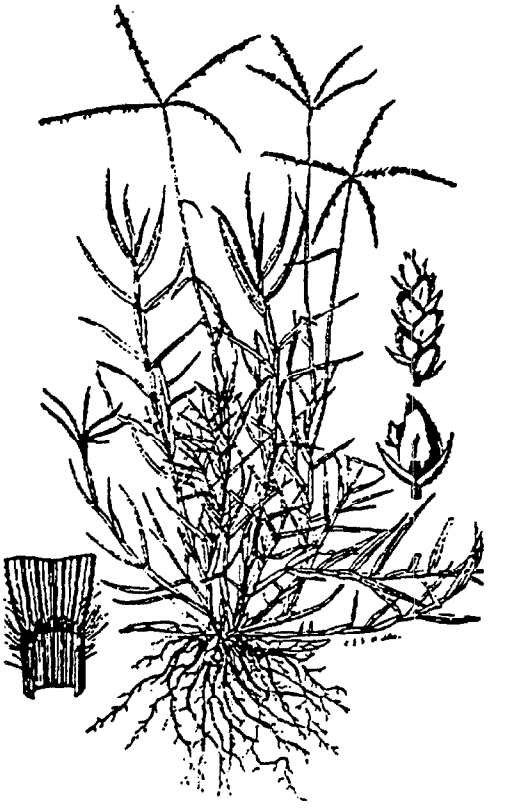
*Red Fescue (Festuca rubra)*

5. Bermudagrass (Cynodon dactylion)

Uses: Soil and water conservation, pasture, hay, silage, lawns, both high maintenance and general purpose turf, and stabilization of grassed waterways.

Description: A long-lived, warm season perennial that spreads by stolons and rhizomes (runners and underground stems). Height of stems of Common Bermudagrass may be 12 inches. The stems are short-jointed and the leaves flat and spreading. Common Bermudagrass may be established vegetatively with sprigs (sections of stems) or from seeds; however, it has the potential to develop into a weed problem because it spreads vigorously. Cold-tolerant hybrids are usually specified. These are traditionally established from sprigs or sod, but seed is now available.

Adaptation: Southern Piedmont and Coastal Plain in Virginia and some southern appalachian ridges and valleys. Check Std. & Spec. 3.34 for regional adaptations of varieties. Makes its best growth when average daily temperatures are above 75 degrees. Grows on a wide range of soils from heavy clays to deep sands. Optimum pH is 6.0 to 6.5. It is drought-resistant and salt-tolerant. Tolerates floods of short duration but will not thrive on waterlogged soils; does not persist under heavy shade. For rough areas, the varieties Midland (a forage hybrid) and Coastal are recommended. For fine-turf areas, Tufcote (a fine-leaved turf hybrid), Midiron, Tifway, and Vamont are used in Virginia.



Bermudagrass (Cynodon dactylion)

Establishment: By sodding or planting sprigs. Sprigs should be planted (by hand or machine) when soil is warm in a well-prepared, moist seedbed. One end of the sprig should extend above ground, and the other should be covered by firmly packed soil.

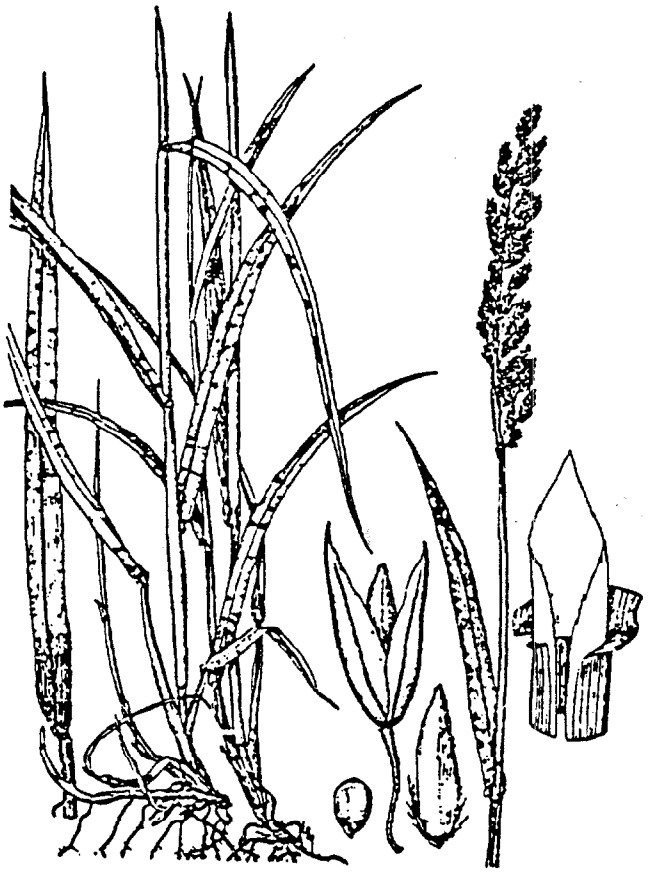
Sources: Readily available as seed, sprigs, and sod.

6. Reed Canarygrass (Phalaris arundinacea)

Uses: Pasture, hay silage, and erosion control. An excellent grass for stabilizing waterways, healing and controlling gullies, and protecting shorelines of ponds and reservoirs from wave action. Also provides good cover for shooting preserves. Can be used in deep gullies and drainage ditches where streamflow is rapid. Vigorous growth may impede flow in small, low velocity channels.

Description: A long-lived, cool season, clumpy perennial with coarse rhizomes (underground stems). Grows 4 to 7 feet tall. Most widely used variety is Ioreed.

Adaptation: Throughout Virginia. Does best in a cool, moist climate. Makes best growth on fertile, moist, medium to fine soils; but will grow in a wide range of soil moisture conditions. Will also grow well on swampy or floodplain soils consisting of peat, muck or sand. Will withstand flooding, yet is quite drought-tolerant when mature. Optimum pH range 5.0 to 7.5.



*Reed Canarygrass (Phalaris arundinacea)*

Establishment: Requires a well-prepared seedbed that is firm and weed free. Seed in spring or late summer; drill seed alone or with a legume. Seed must be fresh - it should be labeled as having at least 70% germination tested within the last 6 months. Normally, pure stands should be established because this grass is not very compatible with other plants. Mowing should not occur more than twice a year on stabilized critical erosion areas or waterway as this will result in reduced stands.

Sources: Available commercially.

## MISCELLANEOUS EROSION CONTROL GRASSES

1. Weeping Lovegrass (Eragrostis curvula)

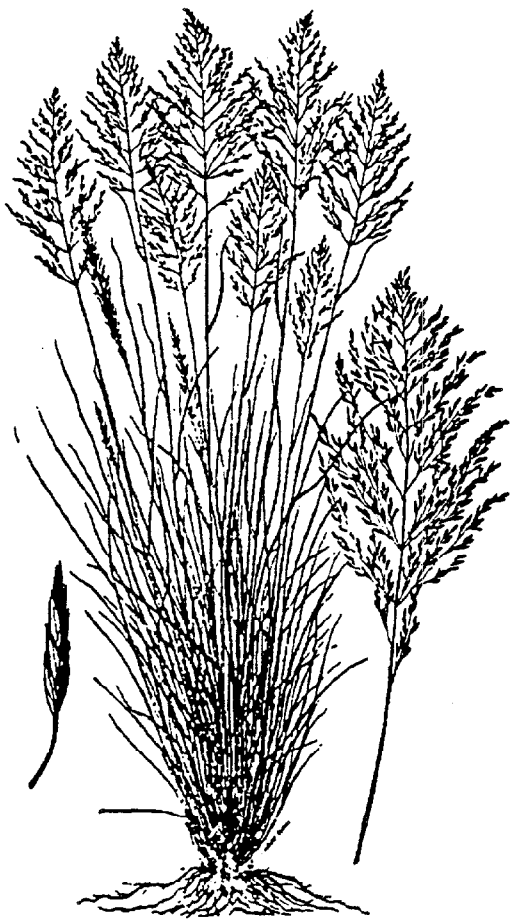
Uses: Fast-growing cover for erosion control. In the northeast, weeping lovegrass acts as a summer annual. The normal life of 3 to 5 years may be foreshortened by low winter temperatures. May provide permanent cover on southern exposure.

Description: A rapid-growing, warm season bunch grass introduced from East Africa. The long, narrow leaves are numerous, very fine, and droop over to the ground, hence the name. Leaf height is rarely above 12 inches.

Adaptation: Prefers light-textured, well-drained soil; will thrive on soil of low fertility. Low winter temperatures may deplete stand.

Establishment: Easy to establish by seed; germinates rapidly and grows quickly. Lime and fertilizer needs are similar to those of Tall Fescue and Ryegrass. Requires pH of 5.5 or higher. May be planted any time after danger of frost and throughout the summer. Very fine seed, commonly added to erosion control seed mixtures. Use of hydroseeders is successful if the seeding rate is increased to compensate for the lack of a firm seedbed. Normal seeding rates are 5 to 20 lbs. per acre in mixes.

Sources: Readily available from large seed companies.



*Weeping Lovegrass (Eragrostis curvula)*

2. Redtop (Agrostis alba)

Uses: Erosion control, pasture, companion grass in turf seedings and stabilizing ditch and channel banks, grassed waterways, and other disturbed areas.

Description: A coarse, cool season perennial grass with rhizomes (underground stems). Grows to 30 to 40 inches.

Adaptation: Throughout Virginia; does better in the cool, humid areas. Will grow under a wide variety of soil and moisture conditions. Grows on very acid soils (pH 4.0 to 7.5) and poor, clay soils of low fertility. While drought-resistant, it is also a useful wetland grass.

Establishment: Has very small seed and requires a compact seedbed. May be sown in early spring or late summer. Seldom seeded alone except as temporary turf. Adequate fertilization is essential on critical areas to obtain good cover rapidly. Most commonly added to mixes, usually 2 to 3 lbs. per acre. Redtop will disappear from a stand under frequent low mowing.

Sources: Available from commercial sources.

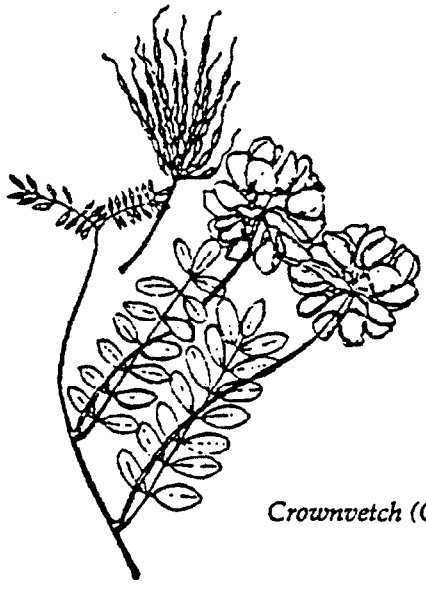
*Redtop (Agrostis alba)*

## LEGUMES

1. Crownvetch (Coronilla varia)

Uses: For erosion control of critical areas such as steep roadbanks, surface mine spoil and industrial waste areas. It is also useful as a residential ground cover. It provides high-quality forage for ruminant animals and serves as a wildlife food and cover plant.

Description: A deep-rooted, cool season, perennial, herbaceous legume with a semi-reclining growth habit. It reaches 2 to 3 feet in height, and does not climb or twine. It fixes nitrogen in the soil and makes a dense mat of vegetative cover.



*Crownvetch (Coronilla varia)*

Adaptation: Best adapted to the northern Piedmont and Mountain regions of Virginia. It grows best on well-drained soils with a pH range of 5.5 to 8.3. It will persist on more acid soils for a prolonged period once established. It is not adapted to soils with poor drainage. Crownvetch is winter-hardy and drought-tolerant. Varieties commonly used are Chemung, Penngift and Emerald.

Establishment: Only inoculated seed should be used. Requires at least 500 lbs. per acre of 5-10-10 fertilizer (or the area should be fertilized according to soil test results). Soil acidity must be raised above a pH of 5.5. Crownvetch requires mulch and can be hydroseeded successfully. Seeding in the spring is most successful. Frost-seeding may be used on steep or stony sites (seed in late winter, and allow frost action to work the seed into soil). Crownvetch often takes 2 to 3 years to establish a dense stand. A companion grass such as Perennial Ryegrass or Redtop needs to be mixed into the initial planting, but the Crownvetch will eventually crowd out the companion plants. It will not persist under frequent mowing.

Sources: Available commercially.

2. Flatpea (Lathyrus sylvestris)

Uses: Flatpea is an erosion control plant that provides a thick mat of vegetative cover, fixes nitrogen in the soil, and can be maintained with a minimum of management. It is useful on roadbanks, dams, borrow area, gravel pits, surface mine spoil, and industrial waste areas. It is an ideal plant for stabilizing logging roads and utility right-of-ways since it will restrict the invasion of many woody species. It also provides good wildlife cover and food.

Description: A cool season perennial legume. It will climb to a height of 6 to 7 feet if support is available, but the normal height is 2 to 3 feet.

*Flatpea (Lathyrus sylvestris)*

Adaptation: Flatpea is adaptable to a wide variety of soil conditions. It is drought-tolerant, cold-hardy, and does well on low-fertility sites such as sands, gravels, and soils from acid sandstones. It is not adapted to wet sites, but it will grow on somewhat poorly drained soils. It will tolerate minor shade and a minor degree of flooding. The optimum pH range is from 6.0 to 6.5. The only available variety is Lathco, developed by the USDA-Soil Conservation Service.

Establishment: Use only inoculated seed. The seedbed should be scarified, if possible. The seed is normally drilled or band seeded, but on rough sites or steep slopes, it can be broadcast and then worked into the soil by light dragging. Where possible, a light application of mulch, properly anchored, will assure a good stand. Lime is essential if the soil is below a pH of 5.0. Fertilize according to a soil test or apply 400 lbs. per acre of 10-20-10. Work lime and fertilizer into soil when preparing

the seedbed. For a primary stand, use a seeding rate of 30 to 40 lbs. in a mixture with 8 to 10 lbs. of Perennial Ryegrass or 10 to 15 lbs. of Tall Fescue. Flatpea is slow to germinate, so grasses are needed to provide quick cover. Early spring seedings in April or May are best; June seedings are less desirable. Grass seedings may be overseeded with Flatpea from November through March. Flatpea is usually not winter-hardy if seeded in mid or late summer; therefore, dormant seedings are recommended. Mulch with straw at a minimum rate of 1-1/2 tons per acre on all critical sites, and anchor. Little management is required. Remove woody vegetation if the site is invaded. Mowing is acceptable once the stand is established. Mow after full bloom at a 6-inch minimum height.

Sources: Lathco is commercially available.

3. Sericea Lespedeza (Lespedeza cuneata)

Uses: Hay, pasture, erosion control, cover crop, wildlife food.

Description: Warm season perennial legume with upright woody stems 12 to 18 inches tall. Roots widely branched penetrating soil 3 feet or more.

Adaptation: Well adapted to all parts of Virginia. Best on well-drained, deep soils of medium texture. Will also grow on sandy, rather acidic, infertile soils. Most often the legume of choice for eastern Virginia. Optimum pH range is 6.0 to 6.5, but will tolerate a range of 5.0 to 7.0. It is drought-tolerant. Common varieties in Virginia are Serala and Interstate.

*Sericea Lespedeza (Lespedeza cuneata)*

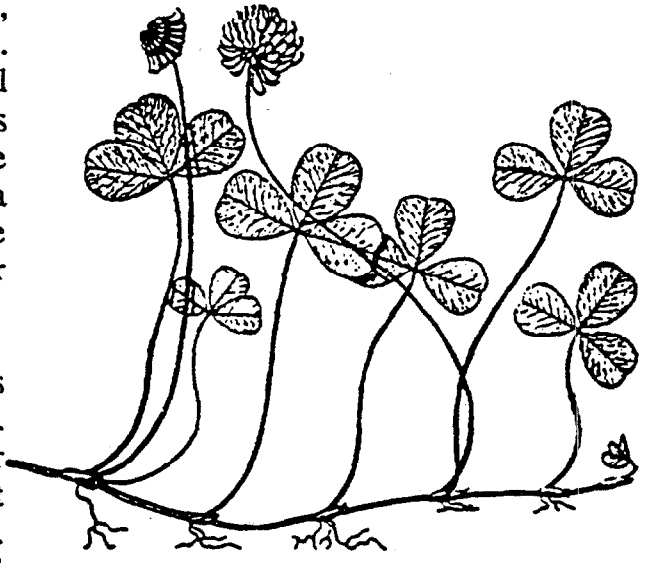
Establishment: Seed from April to June. Requires a firm seedbed. Use only inoculated seed. Rates vary from 20 to 30 lbs. of unhulled seed per acre. Requires phosphate and potash. Will not persist under frequent mowing (once a year recommended).

Sources: Seed of common varieties is commercially available.

4. White Clover (Trifolium repens)

Uses: Common White Clover is used mostly for pastures. Ladino clover, a giant white clover, is also used for hay and silage in mixtures with a grass. The thick-growing, spreading characteristics of the common type make it ideal for erosion control.

Description: A cool season perennial legume. The common type has a prostrate type of growth, while the Ladino is more upright. Both spread by stolons (horizontal branches along ground) and by roots at the nodes. Representative common varieties used in Virginia are Tillman, Common and White Dutch. Ladino is the only cultivar for the large type.



*White Clover (Trifolium repens)*

Adaptation: Thrives in cool climates and on moist, rich soils with full sun. Will not tolerate extremes of cold or drought. Where soil moisture is not adequate, Ladino is short-lived. Optimum soil pH is 6.5, but it will grow in a range of 5.0 to 7.5. Common White Clover volunteers readily in Bluegrass mixtures where moderate to high fertility is maintained. Stands are persistent.

Establishment: Ladino Clover requires inoculation, fertilizing, and liming for successful growth. Phosphorus and potash are the key fertilizer elements required. Ladino makes a good companion crop with grasses such as Orchardgrass, Bromegrass, Tall Fescue and Timothy. These grasses will normally crowd out the Ladino after 2 to 3 years. Seed should be planted (drilled or broadcast) at shallow depths, and a firm seedbed is desirable.

Sources: Available commercially.

## APPENDIX 3.32-d

### TABLE 3.32-F

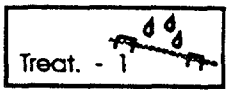
### LBS. OF GROUND AGRICULTURAL LIMESTONE* PER THOUSAND SQUARE FEET NEEDED TO CORRECT pH LEVEL OF ACID SOILS TO 6.5

| Existing pH | Soil Texture | | |
|---|---|---|---|
| | Sandy Loam | Loam | Clay Loam |
| 6.2 | 20 | 35 | 40 |
| 6.0 | 40 | 55 | 70 |
| 5.8 | 55 | 65 | 85 |
| 5.6 | 70 | 80 | 105 |
| 5.4 | 90 | 100 | 125 |
| 5.2 | 105 | 120 | 140 |
| 5.0 | 120 | 140 | 160 |
| 4.8 | 125 | 180 | 205 |
| 4.6 | 155 | 210 | 230 |
| 4.0 | 200 | 250 | 300 |

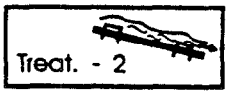
* Lime should always be applied in accordance with the results of a soil test, such as may be obtained through the soil testing laboratory at VPI&SU or through a reputable commercial laboratory.

Source: DSWC's Basic Urban E&S in Virginia

STD & SPEC 3.36




or




# SOIL STABILIZATION BLANKETS & MATTING

B/M

## Definition

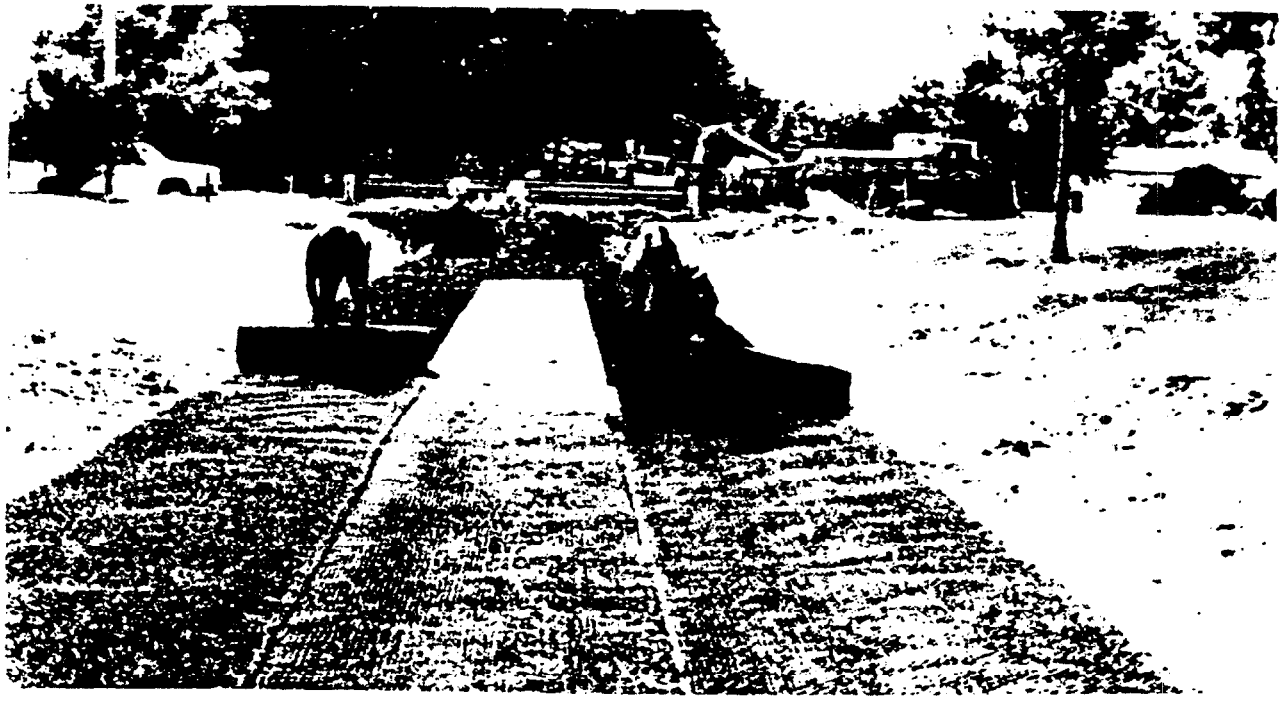
The installation of a protective covering (blanket) or a soil stabilization mat on a prepared planting area of a steep slope, channel or shoreline.

## Purpose

To aid in controlling erosion on critical areas by providing a microclimate which protects young vegetation and promotes its establishment. In addition, some types of soil stabilization mats are also used to raise the maximum permissible velocity of turf grass stands in channelized areas by "reinforcing the turf" to resist the forces of erosion during storm events.

## Conditions Where Practice Applies

On short, steep slopes where erosion hazard is high and planting is likely to be too slow in providing adequate protective cover; in vegetated channels where the velocity of design flow exceeds "allowable" velocity; on streambanks or tidal shorelines where moving water is likely to wash out new plantings; or in areas where the forces of wind prevent standard mulching practices from remaining in place until vegetation becomes established.



## Planning Considerations

Soil stabilization blankets and mats can be applied to problem areas to supplement nature's erosion control system (vegetation) in its initial establishment and in providing a safe and "natural" conveyance for high velocity stormwater runoff. They are being used today in many applications were previously a structural lining would have been required. Care must be taken to choose the type of blanket or matting which is most appropriate for the specific needs of a project. Two general types of blankets and mats are discussed within this specification. However, with the abundance of soil stabilization products available today, it is impossible to cover all the advantages, disadvantages and specifications of all manufactured blankets and mats. Therefore, as with many erosion control-type products, there is no substitute for a thorough understanding of the manufacturer's instructions and recommendations and a site visit by a designer or plan reviewer to verify a product's appropriateness.

**Treatment-1** is a degradable soil stabilization blanket which includes "combination" blankets consisting of a plastic netting which covers and is intertwined with a natural organic or man-made mulch; or, a jute mesh which is typically homogeneous in design and can act alone as a soil stabilization blanket.

It should be used to help establish vegetation on previously disturbed slopes - normally problem slopes of 3:1 or greater. Since the materials which compose the soil stabilization blankets will deteriorate over time, they should be used in permanent conveyance channels with the realization that the system's resistance to erosion is based on the type of vegetation planted and the existing soil characteristics. During the establishment of vegetation, **Treatment-1** should not be subjected to shallow or deep concentrated flows moving at greater than 4 feet/second.

**Treatment-1** provides the following benefits in the achievement of vegetative stabilization when properly applied over seed and required amendments:

1. Protection of the seed and soil from raindrop impact and subsequent displacement.

2. Thermal consistency and moisture retention for seedbed area.

3. Stronger and faster germination of grasses and legumes.

4. Planing off excess stormwater runoff.

5. Prevention of sloughing of topsoil added to steeper slopes.

**Treatment-2** is a soil stabilization matting which consists of a non-degradable, 3-dimensional plastic structure which can be filled with soil prior to planting. This configuration provides a matrix for root growth where the matting becomes entangled and penetrated by roots, forming continuous anchorage for surface growth and promoting enhanced energy

dissipation. **Treatment-2** can be used on problem slopes (normally 3:1 or greater), and in stormwater conveyance channels.

In addition to those benefits noted for **Treatment-1**, **Treatment-2** provides the following benefits in the achievement of vegetative stabilization and in the replacement of more traditional channel linings such as concrete and riprap:

1. Causes soil to drop out of stormwater and fill matrix with fine soils which become the growth medium for the development of roots.

2. When embedded in the soil within stormwater channels, it acts with the vegetative root system to form an erosion resistant cover which resists hydraulic lift and shear forces.

Since **Treatment-2** is non-degradable, it can be used in permanent conveyance channels and can withstand higher velocities of flow than the vegetation and soil would normally allow. However, a 10 feet/second velocity of flow should be the maximum allowed in a conveyance system which utilizes **Treatment-2.**

VDOT Nomenclature and Product Information

The Virginia Department of Transportation has its own nomenclature for many of the standards and specifications found in this handbook; this is true in the case of soil stabilization blankets and matting. The following relationship exists between the two methods of naming the practice:

| Va. E&S-C Handbook | | VDOT Specifications |
|---|---|---|
| **Treatment-1** | (is equivalent to) | EC-2 |
| **Treatment-2** | (is equivalent to) | EC-3 |

It is recommended that most current VDOT "Approved Products List" for these products be consulted prior to installation of a particular blanket or mat. Importantly, the list names those products approved for a certain range of flow velocities when **Treatment-2** (VDOT's EC-3) installation is contemplated.

## TREATMENT-1: SOIL STABILIZATION BLANKET

(Allowable Velocity Range During Vegetation Establishment: 0 - 4 f.p.s.)

### Materials

1. Combination Blankets - They shall consist of a photo-degradable plastic netting which covers and is entwined in a natural organic or man-made mulching material.

The mulching material shall consist of wood fibers, wood excelsior, straw, coconut fiber, or man-made fibers, or a combination of the same. The blanket shall be of consistent thickness with the mulching material/fibers evenly distributed over its entire length. The mulching material/fibers must interlock or entwine to form a dense layer which not only resists raindrop impact, but will allow vegetation to penetrate the blanket.

The blanket shall be nontoxic to vegetation and to the germination of seed and shall not be injurious to the unprotected skin of humans. At a minimum, the plastic netting must cover the top side of the blanket and possess a high web strength. The netting shall be entwined with the mulching material/fiber to maximize strength and provide for ease of handling.

2. Jute Mesh - It shall be of a uniform, open, plain weave, of undyed and unbleached single jute yarn. The yarn shall be of loosely twisted construction and shall not vary in thickness by more than one half of its normal diameter. Jute mesh shall be new and shall conform to the following:

   a. Length of jute mesh shall be marked on each roll.

   b. There shall be 0.60-inch openings (± 25%) between strands, lengthwise.

   c. There shall be 0.90-inch openings (± 25%) between strands, lengthwise.

   d. Weight shall average 0.90 lbs./square yard with a tolerance of 5%.

   As previously noted, jute mesh provides such good coverage (large surface area of strands) and contains such small openings that it can be used alone as a blanket.

3. Other Treatment-1 Products - These shall conform to manufacturer's specifications and be approved by the Plan-Approving Authority prior to being specified for a particular application. These products should be installed in accordance with manufacturer's recommendations, provided those recommendations are at least as stringent as this specification. Again, it is recommended that VDOT's "Approved Products List" be consulted. In no case shall these products cover less than 30% of the soil surface.

4. Staples - Staples for anchoring Treatment-1 shall be No. 11-gauge wire or heavier. Their length shall be a minimum of 6 inches. A larger staple with a length of up to 12 inches should be used on loose, sandy, or unstable soils.

## Installation Requirements

Site Preparation - After site has been shaped and graded to approved design, prepare a friable seedbed relatively free from clods and rocks more than 1½ inches in diameter and any foreign material that will prevent uniform contact of the protective covering with the soil surface.

Planting - Lime, fertilize, and seed in accordance with seeding or other type of planting plan. When using jute mesh on a seeded area, apply approximately one-half the seed after laying the mat. The protective covering can be laid over sprigged areas where small grass plants have been inserted into the soil. Where ground covers are to be planted, lay the protective covering first and then plant through the material as per planting design.

When open-weave nets are used, lime, fertilizer, seed and mulch should be applied before laying the net. When a combination blanket (such as an "excelsior" blanket) is used, seed and soil amendments must also be applied before the blanket is laid.

Orientation - See Plate 3.36-1 for orientation of **Treatment-1** for different topographic conditions.

Laying and Stapling (see Plate 3.36-2) - If instructions have been followed, all needed check slots will have been installed, and the protective covering will be laid on a friable seedbed free from clods, rocks, roots, etc. that might impede good contact.

1. Start laying the protective covering from the top of the channel or top of slope and unroll down-grade.

2. Allow to lay loosely on soil - do not stretch.

3. Upslope ends of the protective covering should be buried in a anchor slot no less than 6-inches deep. Tamp earth firmly over the material. Staple the material at a minimum of every 12 inches across the top end.

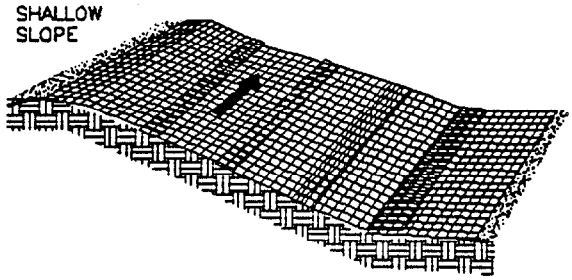
4. Edges of the material shall be stapled every 3 feet. Where multiple widths are laid side by side, the adjacent edges shall be overlapped a minimum of 2 inches and stapled together.

5. Staples shall be placed down the center, staggered with the edges at 3 foot intervals.

Check slots - On highly erodible soils and on slopes steeper than 4:1, erosion check slots should be made every 50 feet (see Plate 3.36-2). Insert a fold of the material (separate piece) into a 6-inch trench and tamp firmly. Staple fold to "main" blanket at minimum 12-inch intervals across the upstream and downstream portion of the blanket.

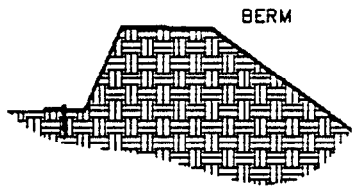
# TYPICAL ORIENTATION OF TREATMENT – 1 (SOIL STABILIZATION BLANKET)

SHALLOW SLOPE

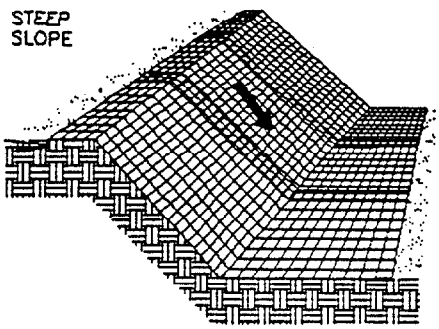


ON SHALLOW SLOPES, STRIPS OF NETTING PROTECTIVE COVERINGS MAY BE APPLIED ACROSS THE SLOPE.

WHERE THERE IS A BERM AT THE TOP OF THE SLOPE, BRING THE MATERIAL OVER THE BERM AND ANCHOR IT BEHIND THE BERM.

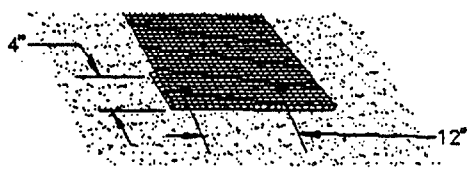


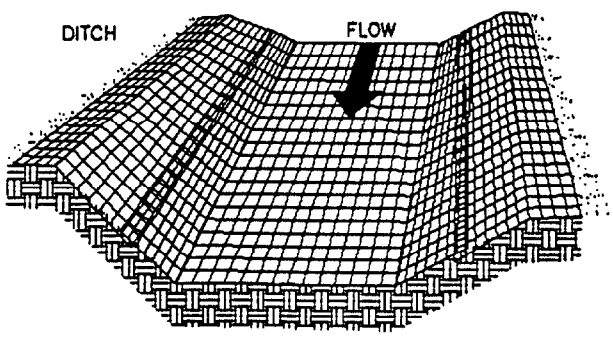

STEEP SLOPE



ON STEEP SLOPES, APPLY PROTECTIVE COVERING PARALLEL TO THE DIRECTION OF FLOW AND ANCHOR SECURELY.

BRING MATERIAL DOWN TO A LEVEL AREA BEFORE TERMINATING THE INSTALLATION. TURN THE END UNDER 4" AND STAPLE AT 12" INTERVALS.



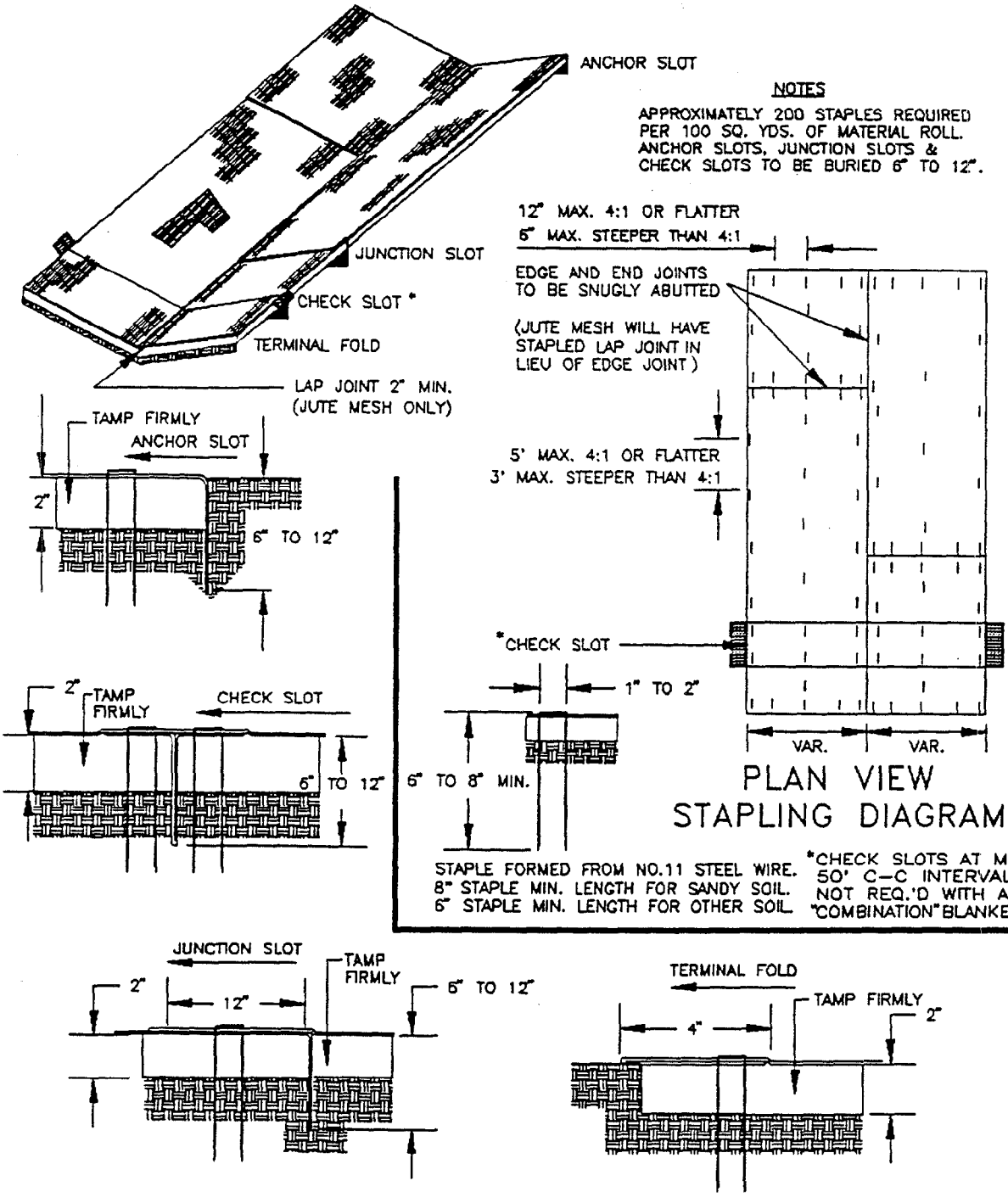




IN DITCHES, APPLY PROTECTIVE COVERING PARALLEL TO THE DIRECTION OF FLOW. USE CHECK SLOTS AS REQUIRED. AVOID JOINING MATERIAL IN THE CENTER OF THE DITCH IF AT ALL POSSIBLE.

Source: Adapted from Ludlow Products Brochure

Plate 3.36-1

# TYPICAL TREATMENT – 1
# (SOIL STABILIZATION BLANKET)
# INSTALLATION CRITERIA




Source: VDOT Road and Bridge Standards

Plate 3.36-2

Note: Many combination blankets are designed and manufactured to resist movement and uplift to a point which check slots may not be required. Plan designers and review authorities are urged to study manufacturers' recommendations and site conditions.

Joining Protective Coverings - Insert a new roll of material into an anchor slot, as with upslope ends. Overlap the end of the previous roll a minimum of 12 inches, and staple across the end of the roll just below the anchor slot and across the material every 12 inches.

Terminal End - At the point at which the material is discontinued, or at which time the protective covering meets a structure of some type, fold 4 inches of the material underneath and staple every 12 inches (minimum).

At bottom of slopes - Lead net out onto a level area before anchoring. Turn ends under 4 inches, and staple across end every 12 inches.

Final Check - These installation techniques must be adhered to:

1. Protective blanket is in uniform contact with the soil.
2. All lap joints are secure.
3. All staples are driven flush with the ground.
4. All disturbed areas have been seeded.

## TREATMENT-2: SOIL STABILIZATION MATTING

(Allowable velocity range after vegetative establishment: 0 - 10 f.p.s.)

### Materials

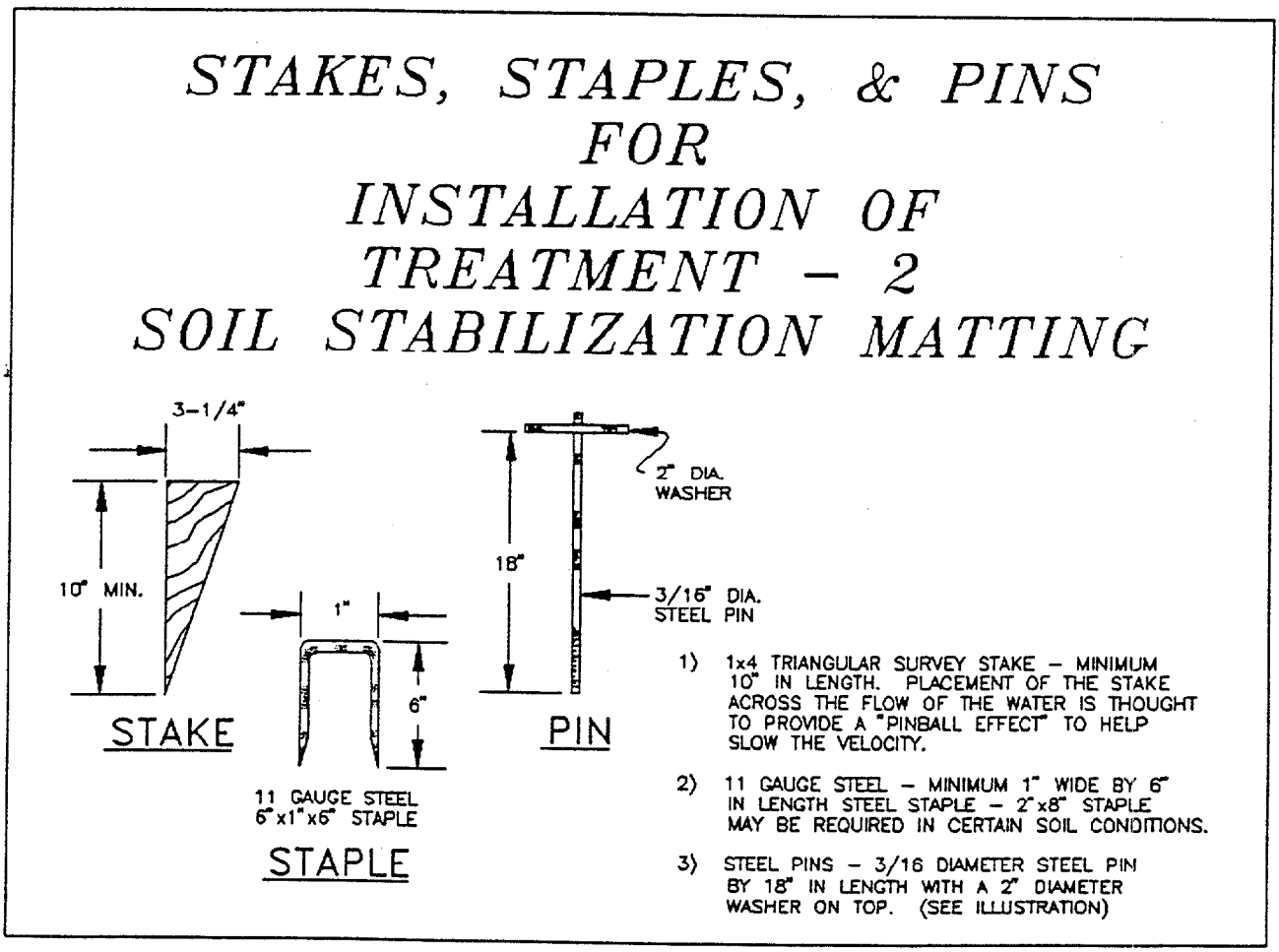
Matting - The majority of these products provide a three dimensional geomatrix of nylon, polyethylene, or randomly oriented monofilaments, forming a mat. These products contain ultra violet (UV) inhibiting stabilizers, added to the compounds to ensure endurance and provide "permanent root reinforcement."

The three dimensional feature creates an open space which is allowed to fill with soil. The roots of the grass plant become established within the mat itself, forming a synergistic root and mat system. As the grass becomes established, the two actually "reinforce" each other, preventing movement or damage to the soil. Allowable velocities are increased considerably over natural turf stands.

Selection of the appropriate matting materials along with proper installation become critical factors in the success of this practice. VDOT's "Approved Products List" can be a real asset in the selection process. Consultation with the supplier or the manufacturer and thorough

evaluation of performance data to ensure proper selection of a soil stabilization matting are also essential. Although many manufacturers claim their products may inhibit erosion associated with channel velocities of up to 20 ft./sec., it is recommended that any velocities that exceed 10 ft./sec. be properly protected with some form of structural lining (see Std. & Spec. 3.17, STORMWATER CONVEYANCE CHANNEL).

Staples - Staples or anchoring methods and recommendations vary by manufacturers. The expectation of high velocities should dictate the use of more substantial anchoring. Some of the typically recommended stakes, staples and pins are depicted in Plate 3.36-3




Source: Product literature from Greenstreak, Inc. Plate 3.36-3

## Installation Requirements

Site Preparation - After site has been shaped and graded to approved design, prepare a friable seedbed relatively free from clods and rocks more than 1 inch in diameter, and any foreign material that will prevent contact of the soil stabilization mat with the soil surface. If necessary, redirect any runoff away from the ditch or slope during installation.

Planting - Lime, fertilize and seed in accordance with MS #1 and the approved plan, paying special attention to the plant selection that may have been chosen for the matted area. If the area has been seeded prior to installing the mat, make sure and reseed all areas disturbed during installation.

Mulching - Mulch (normally straw) should be applied following installation of **Treatment-2** at rates noted in Std. & Spec. 3.35, MULCHING.

Laying and Securing - See Plates 3.36-4, 3.36-5 and 3.36-6. Similar to installing **Treatment-1**, but Plan Approving Authority's requirements or manufacturer's recommendations must be followed as detailed. The key to achieving desired performance is dependent upon proper installation.

Check Slots - See Plate 3.36-4. Matting manufacturers vary significantly in their check slot requirements. Similar to the installation of **Treatment-1**, a check slot may be required when laying **Treatment-2** to "correct" the flow of water if it has the potential to undermine the matting. Most authorities (including VDOT) require that the sides of the matting also be entrenched, creating a slope shelf for the material to rest on, preventing water from entering under the mat on the sides.

Securing the Material and Joining Mats - Again, product specifications vary - upstream and downstream terminal slots, new roll overlaps and multiple width installations differ by various products and manufacturers.

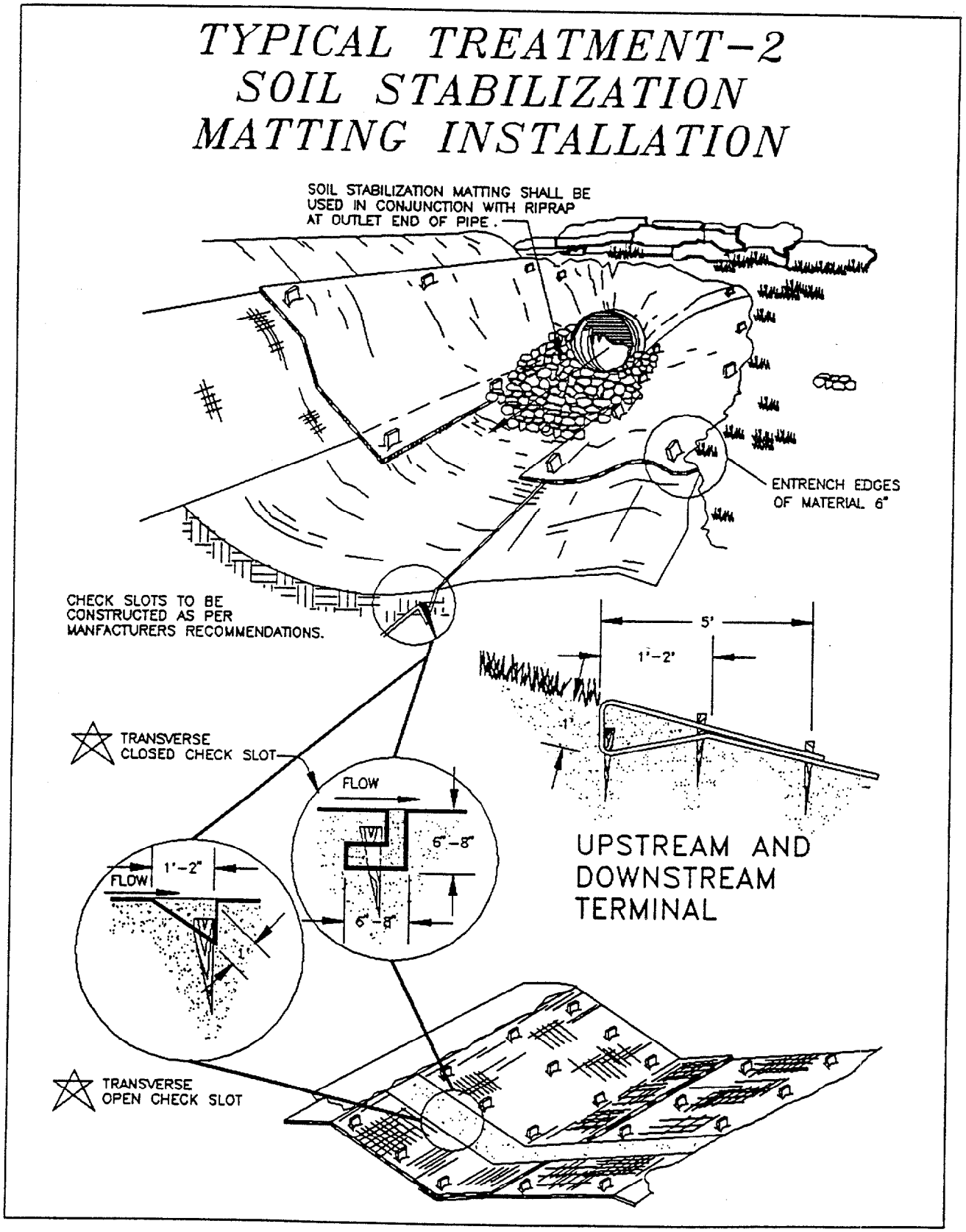
Final Check - These installation techniques must be adhered to:

1. Soil stabilization mat is in uniform contact with the soil.
2. All required slots and lapped joints are in place.
3. The material is properly anchored.
4. All disturbed areas are seeded.

## Maintenance

All soil stabilization blankets and matting should be inspected periodically following installation, particularly after rainstorms to check for erosion and undermining. Any dislocation or failure should be repaired immediately. If washouts or breakage occurs, re-install the material after repairing damage to the slope or ditch. Continue to monitor these areas until which time they become permanently stabilized; at that time an annual inspection should be adequate.

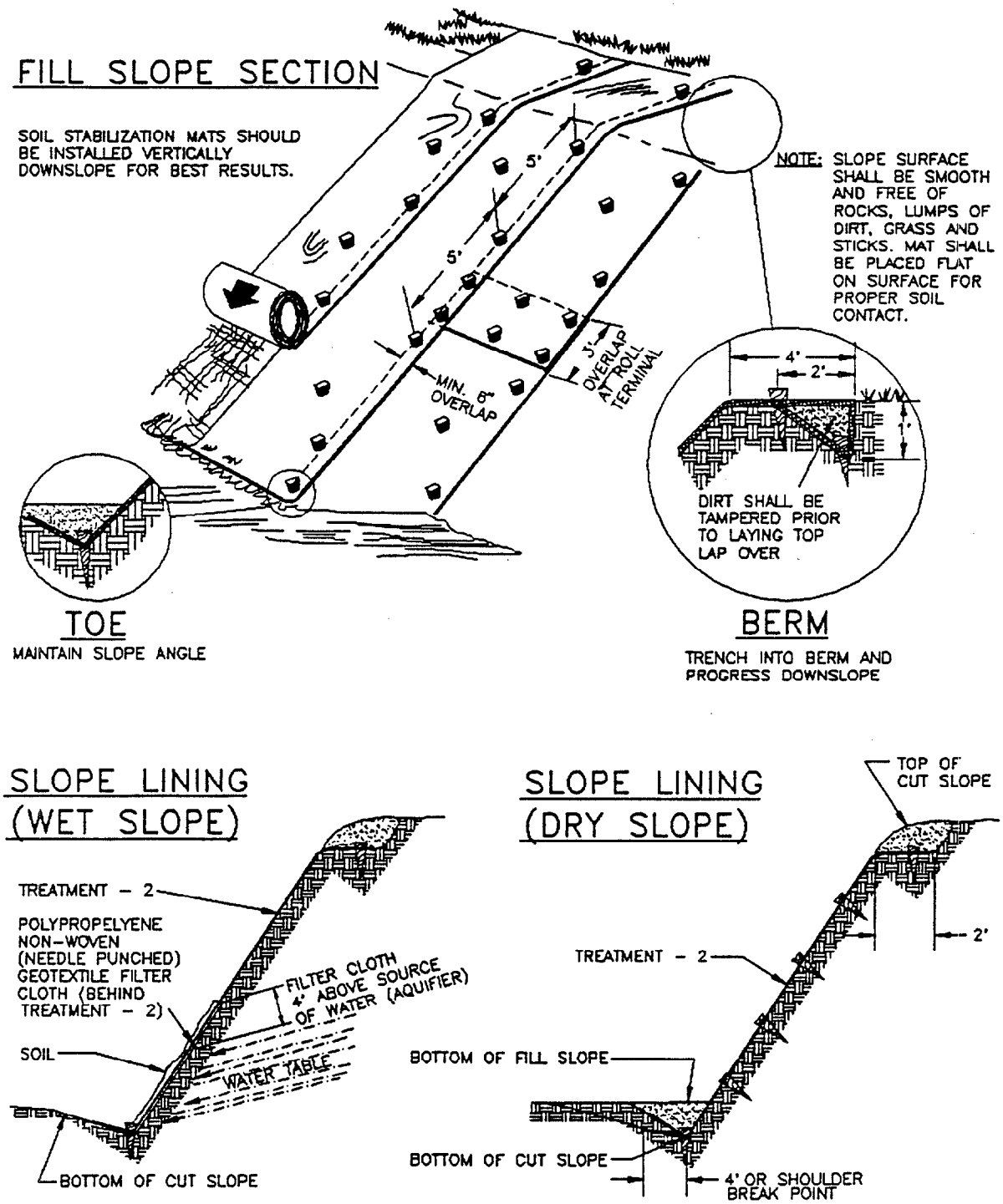
# TYPICAL TREATMENT–2
# SOIL STABILIZATION
# MATTING INSTALLATION




Source: VDOT Road and Bridge Standards

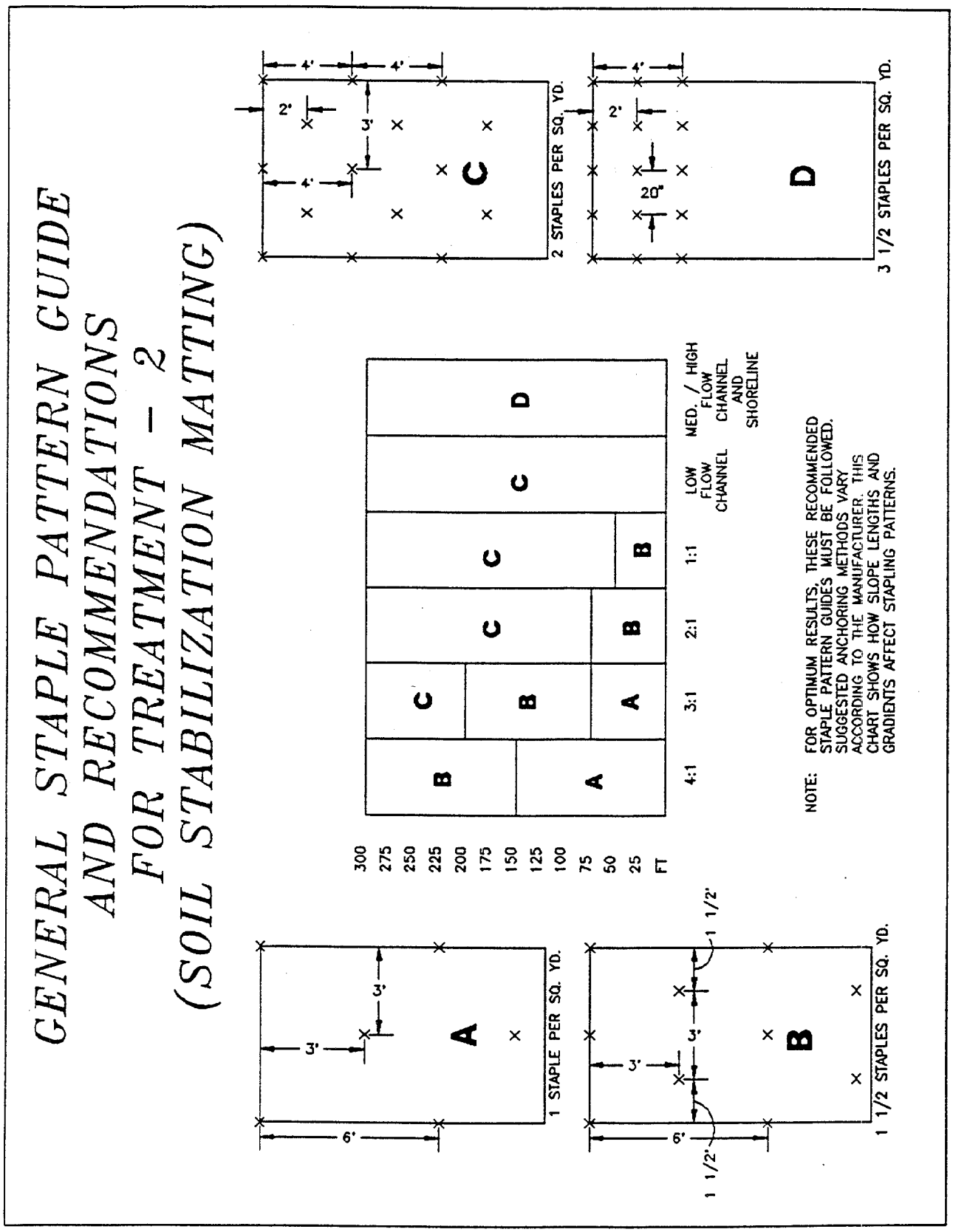
Plate 3.36-4

# TYPICAL TREATMENT – 2
# SOIL STABILIZATION MATTING
# SLOPE INSTALLATION




Source: VDOT Road and Bridge Standards

Plate 3.36-5




Source: Product literature from North American Green

Plate 3.36-6

# *APPENDIX C*
# *SITE-SPECIFIC HEALTH AND SAFETY PLAN*

# HEALTH AND SAFETY PLAN
# FOR
# PILOT SCALE TREATABILITY STUDY FOR EXPLOSIVES-CONTAMINATED SOILS
# NAVAL WEAPONS STATION YORKTOWN
# YORKTOWN, VIRGINIA

Prepared for:

DEPARTMENT OF THE NAVY
Contract No. N62470-93-D-3032
Delivery Order 0113

Prepared by:

OHM Remediation Services Corp.
Trenton, New Jersey

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Regional Industrial Hygienist

Robert A. Brooks, CSP
Health and Safety Manager

Reviewed by:

Mark Kravecz
Project Manager

Kevin J. McMahon, M.S., CIH
Health and Safety Director/Program CIH

John P. Franz, P.E.
Program Manager

August 5, 1996
OHM Project 18757HS

OHM Remediation Services Corp.
A Subsidiary of OHM Corporation

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## *TABLE OF CONTENTS (CONTINUED)*

# 1.0 INTRODUCTION

This Health and Safety Plan (HASP) has been developed for United States Navy, LANTDIV, Delivery Order entitled, Pilot Scale Treatability Study for Explosives-Contaminated Soil, Naval Weapons Station Yorktown, Yorktown, Virginia. The Delivery Order will be executed per the requirements stated in the Final Statement of Work (SOW) for Service Delivery Order per Contract No. N62470-93-D-3032, Delivery Order 0113, in cooperation with the Navy. This Delivery Order will also be executed in accordance with Naval Facilities Engineering Command (NAVFAC).

This HASP documents the policies and procedures which protect workers and the public from potential hazards posed by work at this site and is a key component in the ***OHM Safety Improvement Process***. OHM considers safety the highest priority during work at a site containing potentially hazardous materials and has established a goal of **zero accidents** for all projects. All projects will be conducted in a manner which minimizes the probability of injury, accident, or incident occurrence. This HASP is a key element in the proper planning of project work which is necessary to assure the goal of **zero accidents** is achieved. The HASP Acknowledgment (Appendix A) will be signed by all who actively participate at this project.

Although the plan focuses on the specific work activities planned for this site, it must remain flexible because of the nature of this work. Conditions may change and unforeseen situations may arise that require deviations from the original plan. This flexibility allows modification by the OHM supervisors and health and safety officials with approval from the project CIH.

## 1.1 SITE HISTORY

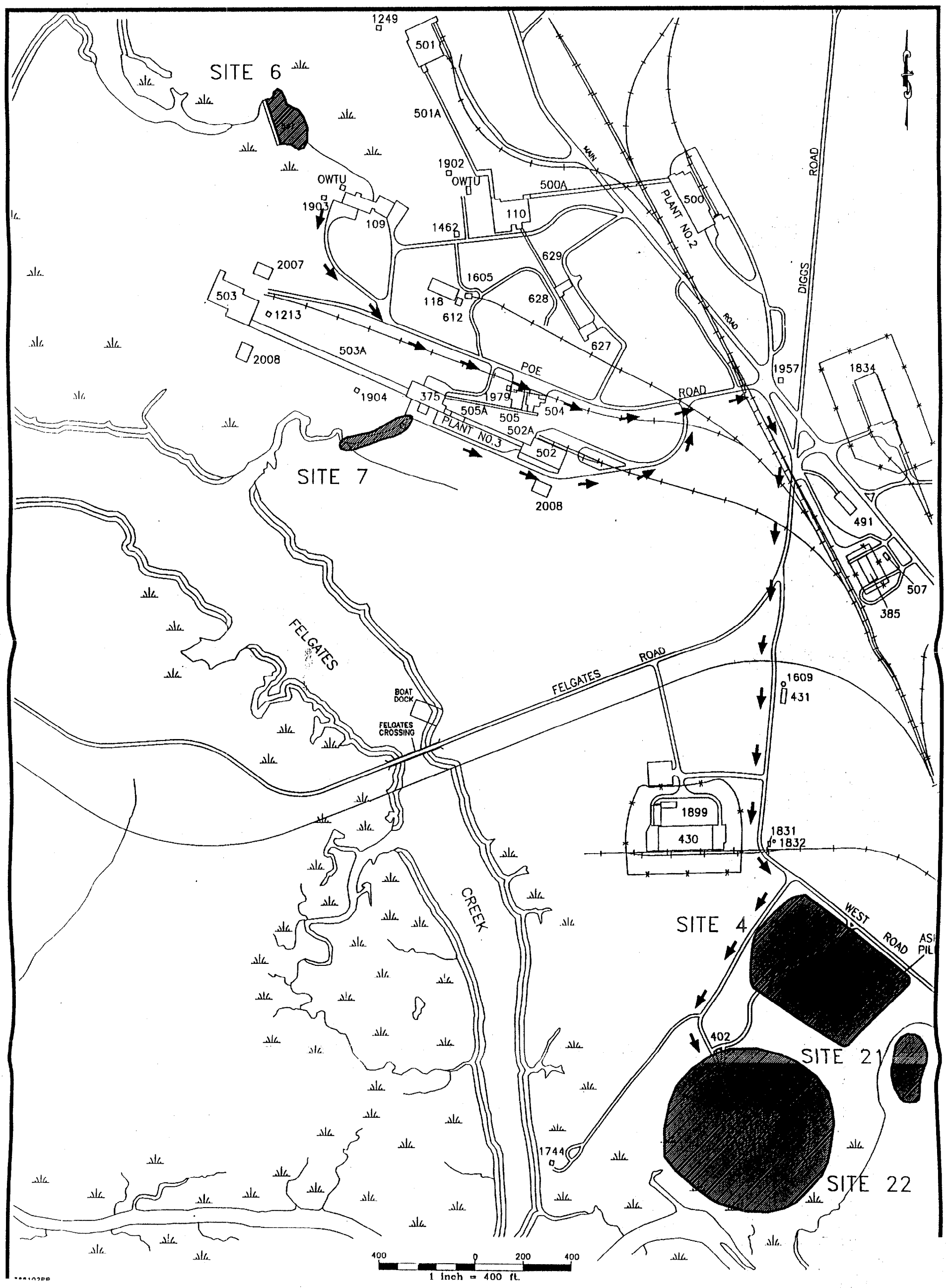
Site 7 is a small drainage area located adjacent to wetlands along a small tributary to Felgates Creek. The site 7 discharge area received explosives contaminated wastewater from Loading Plant 3 from 1945 to 1975. The weapons loading operations released select solvents such as trichloroethene (TCE) and trichloroethane (TCA), and explosive compounds such as 2,4,6-Trinitrotoluene (TNT) and 1,3,5-Trinitro-1,3,5-Triazine (RDX) to the drainage area. Currently the drainage area has reverted to a natural drainage area and does not receive discharge from the Plant 3 complex.

## 1.2 SCOPE OF WORK

The principal tasks to be conducted are listed below.

- Mobilization, site setup
- Clearing, grubbing, tree felling
- Install erosion controls
- Soil excavation
- Biocell construction
- Decontamination pad construction
- Truck loading, hauling
- Equipment decontamination
- Site restoration

These activities have been analyzed for potential hazards for which control measures are provided in Section 3.4 Job Safety Analysis. This HASP has been prepared for the above scope of work. Any changes to the scope of work will require amendment of the plan to remain approved.


SITE 6
SITE 7
SITE 4
SITE 21
SITE 22
1249
501
501A
1902
OWTU
1903
109
1462
110
500A
500
MAIN
PLANT NO.2
ROAD
DIGGS
629
1605
118
612
628
627
2007
503
1213
503A
2008
POE
ROAD
1904
375
1979
505A
505
504
502A
PLANT NO.3
502
1957
1834
491
507
385
FELGATES
FELGATES ROAD
BOAT DOCK
FELGATES CROSSING
1609
431
1899
430
1831
1832
CREEK
WEST ROAD
402
1744
400 0 200 400
1 inch = 400 ft.

00886B02Z

# 2.0 KEY PERSONNEL AND MANAGEMENT

The Project Manager (PM), Site Supervisor (SS), Certified Industrial Hygienist (CIH) Health and Safety Manager (HSM) and Site Safety Officer (SSO) are responsible for formulating and enforcing health and safety requirements, and implementing the HASP. Reporting relationships are shown in Figure 2.1

## 2.1 PROJECT MANAGER (PM)

The PM has the overall responsibility for the project and to assure that the goals of the construction remedial action are attained in a manner consistent with the HASP requirements. The PM will coordinate with the SS and the SSO to assure that the remedial action goals are completed in a manner consistent with the HASP. The PM will conduct a monthly health and safety audit of the project using the Management Safety Improvement Report Form. Specific Key Requirement Areas (KRAs) for safety performance include:

- Implement Site Specific Safety Awareness/ Recognition program if OHM revenue exceeds $200,000
- Conduct site audits of project (Management Safety Improvement Report: 1 report within 1st 30 days; 1 follow up report within 60 days)
- Implement Safety Improvement Team if more than 20 personnel/more than one month in duration
- Investigate and report findings for any OSHA recordable cases; assure corrective actions are taken

## 2.2 SITE SUPERVISOR (SS)

The SS is responsible for field implementation of the HASP. The SS will be the main contact in any on-site emergency situation and will insure off-site emergency agencies have been contacted prior to the start of work. The SS will act as the SSO when the assigned SSO is not on the project site. The SS will conduct periodic inspections (at least weekly) of the work site to confirm compliance with all health and safety requirements. The Project Safety Improvement Checklist shall be used to document inspections. The SS is also responsible for coordinating remedial actions for all deficiencies and for enforcing the OHM "Cardinal Safety Rules." Specific KRAs for safety performance include:

- Complete Site-Specific Job Safety Analyses for all principle tasks
- Implement Site Specific Safety Awareness/ Recognition program
- Conduct weekly safety inspections of the job site
- Implement Safety Improvement Team if more than 20 personnel/more than one month in duration
- Correct all deficiencies as noted on Management Safety Improvement Reports and safety department audits, within recommended time frames
- Investigate and report findings for OSHA recordable cases; assure corrective actions are taken

## 2.3 SITE SAFETY OFFICER (SSO)

The SSO has responsibility for administering the HASP relative to site activities, and will be in the field full-time while site activities are in progress. The SSO's primary operational responsibilities include personal and environmental monitoring, coordination of job safety analyses, selection and care of personal

protective equipment, assignment of protection levels and review of work permits. The SSO will monitor all field activities involved with safety and is authorized to stop work when an imminent health or safety risk exists. The SSO is responsible for informing all on-site personnel of essential safety requirements and facilitating the daily safety meetings. Specific KRAs for SSO performance include:

- Monitor workers for signs of stress, such as cold exposure, heat stress, and fatigue
- Reevaluate site conditions on an on-going basis. Coordinate protective measures including engineering controls, work practices and personal protective equipment
- Assist the SS in the preparation, presentation and documentation of daily safety meetings
- Conduct and prepare reports of daily safety inspections of work processes, site conditions, equipment conditions and submit to SS. Discuss any necessary corrective actions with the SS and review new procedures
- Initiate revisions of the HASP as necessary for new tasks or modifications of existing operations and submit to the Program CIH for approval
- Perform air monitoring as required
- Assist the PM and SS in accident investigations
- Prepare permits for special operations, e.g., hot work, confined spaces, line breaking, etc.
- Maintain site safety records
- Conduct weekly inspections of all fire extinguishers, supplied air respirators, first-aid kits, and eye washes/emergency showers
- Inform subcontractors of the elements of the HASP/contractor pre-job checklist
- Coordinate the preparation of Site Specific Job Safety Analyses with the SS, team leader, and work crew
- Coordinate the daily Safety Observer Program
- Coordinate the Site Specific Safety and Health Awareness and Recognition Program (SHARP) with Project Manager and Supervisor

## 2.4 HEALTH AND SAFETY MANAGER (HSM)

The HSM is responsible for staffing health and safety personnel and monitoring projects for compliance with regulatory and OHM health and safety policies and procedures. This position reports to the Region Health and Safety Director and will audit the site periodically to ensure compliance with this HASP.

## 2.5 PROGRAM CERTIFIED INDUSTRIAL HYGIENIST (CIH)

The Program CIH is responsible for overseeing development of the HASP and ensures that the HASP complies with all federal, state and local health and safety requirements. The Program CIH provides technical and administrative support for the LANTDIV Health and Safety Program. If necessary, the CIH can modify specific aspects of the HASP to adjust for on-site changes that affect safety. The CIH will coordinate with the HSM and SSO on all modifications to the HASP and will be available for consultation when required. The CIH will not necessarily be on site during OHM activities but may make periodic site visits to determine compliance. The CIH reports to the Regional Vice President/General Manager.

## 2.6 EMPLOYEE SAFETY RESPONSIBILITY

Each employee is responsible for personal safety as well as the safety of others in the area. The employee will use all equipment provided in a safe and responsible manner as directed by the SS. All OHM personnel will follow the policies set forth in the OHM Health and Safety Procedures Manual, with

particular emphasis on the OHM "Cardinal Safety Rules." Employees that knowingly disregard safety policies/procedures may be subject to disciplinary actions.

## 2.7 KEY SAFETY PERSONNEL

The following individuals share responsibility for health and safety at the site:

| | |
|---|---|
| Project Manager | Mark Kravecz<br>609-588-6484 (office)<br>800-670-1614 (pager) |
| ROICC | LTJG Leanne Currie<br>804-887--4161 (office) |
| NTR | Richard Stryker<br>757-332-4778 (office) |
| Site Supervisor | Ware Warburton<br>804-888-6732 |
| Site Safety Officer | Ware Warburton<br>804-888-6732 |
| Program Manager for LANTDIV | John P. Franz, P.E.<br>609-588-6477 (office) |
| Health and Safety Manager | Robert A. Brooks, CSP<br>609-588-6423 (office)<br>800-818-2185 (pager) |
| Northeast Region Health and Safety Director/Program CIH | Kevin McMahon, M.S., CIH<br>609-588-6375 (office)<br>609-421-7523 (pager) |
| Vice President, Health and Safety | Fred Halvorsen, Ph.D., PE, CIH<br>800-231-7031 |

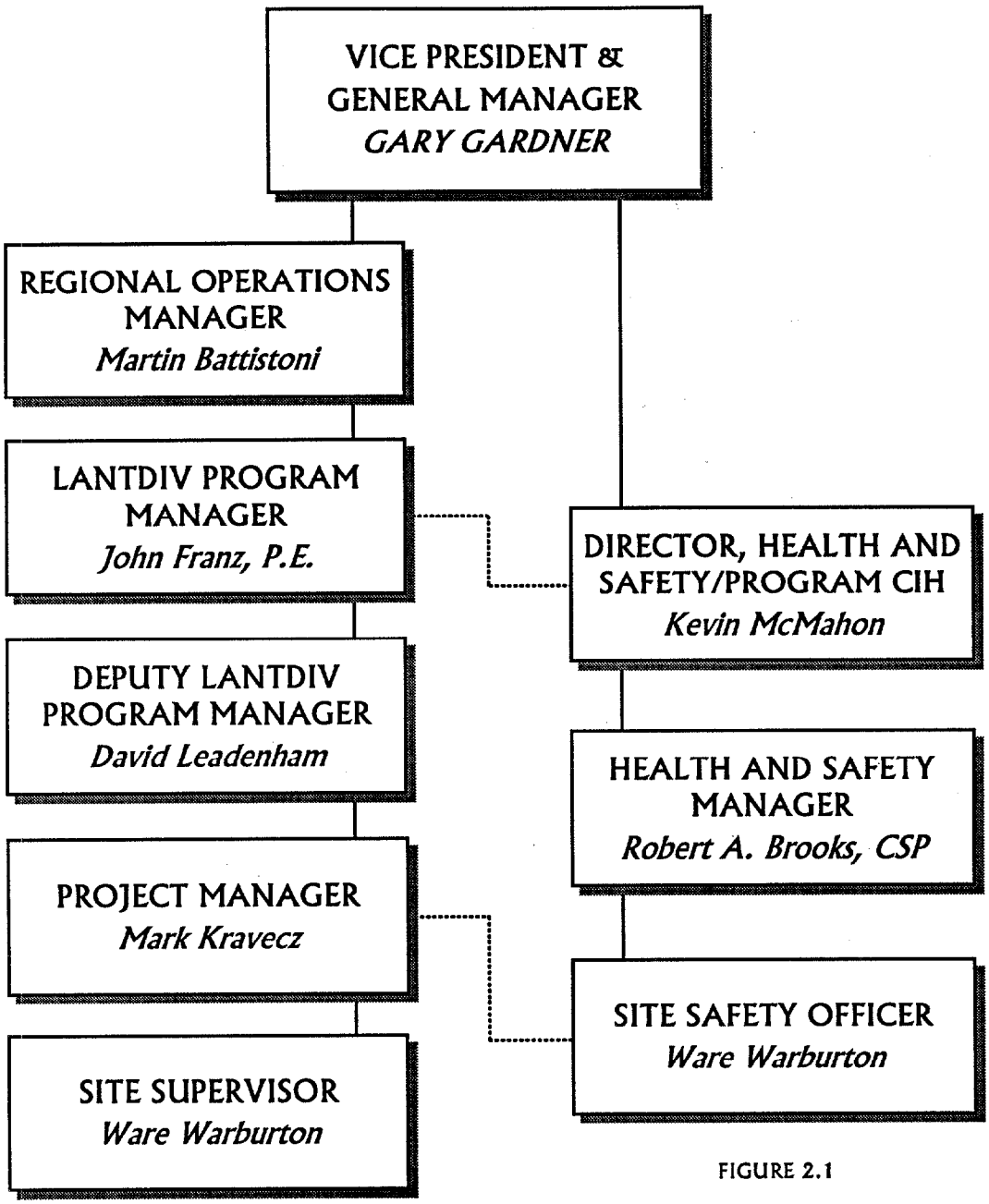



FIGURE 2.1

HEALTH & SAFETY ORGANIZATION
Remedial Action
Pilot Scale Treatability Study for
Explosives-contaminated Soils
Naval Weapons Station Yorktown
Yorktown, Virginia
Delivery Order 0113
OHM Project 18757

Prepared for

DEPARTMENT OF THE NAVY
ATLANTIC DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORFOLK, VIRGINIA

# 3.0 JOB SAFETY ANALYSIS

This section outlines the potential chemical and physical hazards which workers may be exposed to during work on this project. Table 3.1 lists significant contaminants identified at the site. An MSDS list is included in Appendix C.

## 3.1 CHEMICAL HAZARDS

The routes of exposure for chemical substances listed below are primarily inhalation and skin contact. Exposure to these substances is most likely during soil excavation. Skin contact with the ordinance agents (TNT, HMX, RDX) can produce significant toxic effects to exposed individuals. The maximum determined concentrations of TNT in soil is 93,000 ppm; RDX 3,900 ppm; HMX 730 ppm. A water spray directed at the point of excavation will reduce the possibility of dust and particles becoming airborne and reduce the risk of flash ignition of the ordinance agents.

| CHEMICAL | EXPOSURE ROUTES | PEL/TLV | HEALTH HAZARDS/ PHYSICAL HAZARDS |
|---|---|---|---|
| Cyclotetramethylene Tetra-nitramine (HMX) | Skin, eye, inhalation, ingestion | N/E | A skin, eye irritant; a poison; headache, weakness, depressed blood pressure, convulsions, collapse; severe poisoning can damage the optic nerve; blindness |
| | | | A class A explosive; shock sensitive; heating may cause detonation; reacts violently with oxidizers, oxidizing acids; toxic gases released from thermal decomposition |
| 1,1,2 Trichloroethane | Skin, eye, inhalation, ingestion | 10 ppm | A skin, eye and upper respiratory irritant; a CNS depressant; dermatitis; a carcinogen |
| | | | Reacts with strong oxidizers, caustics and chemically active metals; releases toxic gases during combustion |
| Trichloroethylene | Skin, eye, inhalation, ingestion | 50 ppm | A skin and eye irritant; dermatitis; headache, vertigo, visual distortion, fatigue, nausea, vomiting, irregular heart rhythm |
| | | | A dangerous fire hazard, reacts with strong caustics and chemically reactive metals, will emit toxic phosgene gas when heated |
| 2,4,6-Trinitrotoluene | Skin, eye, inhalation, ingestion | 0.5 mg/m$^3$ | A skin, eye, respiratory, mucous membrane irritant; a poison; sneezing, muscular pain, nausea, cyanosis, cardiac irregularity; anemia, jaundice |
| | | | A class A explosive; shock sensitive; heating may cause detonation; reacts violently with oxidizers, oxidizing acids, ammonia, strong alkali; toxic gases released from thermal decomposition |

| CHEMICAL | EXPOSURE ROUTES | PEL/TLV | HEALTH HAZARDS/ PHYSICAL HAZARDS |
|---|---|---|---|
| 1,3,5-trinitro-1,3,5-triazine (RDX, Cyclonite) | Skin, eye, inhalation, ingestion | 1.5 $mg/m^3$ | A corrosive irritant to skin, eyes and mucous membranes; a poison; epileptiform convulsions, cyanosis, collapse |
| | | | A class A explosive; shock sensitive; heating may cause detonation; reacts violently with oxidizers, oxidizing acids, ammonia, strong alkali; toxic gases released from thermal decomposition |

The following general symptoms may indicate exposure to a hazardous material. Personnel will be removed from the work site and provided proper medical attention immediately if the following symptoms occur:

- Dizziness or stupor
- Nausea, headaches, or cramps
- Irritation of the eyes, nose, or throat
- Euphoria
- Chest pains and coughing
- Rashes or burns

## 3.2 PHYSICAL HAZARDS

To minimize physical hazards, OHM has developed standard safety protocols which will be followed at all times. Failure to follow safety protocols will result in expulsion of an employee from the site and appropriate disciplinary actions.

The SS and SSO will observe the general work practices of each crew member and equipment operator, and enforce safe procedures to minimize physical hazards. Hard hats, safety glasses, and steel-toe safety boots are required in all areas of the site. Site-specific hazards and all necessary precautions will be discussed at the daily safety meetings. The Health and Safety Procedures Manual for LANTDIV will be maintained at the project site as a reference document.

## 3.3 ENVIRONMENTAL HAZARDS

Environmental factors such as weather, wild animals, insects, and irritant plants pose a hazard when performing outdoor work. The SSO and SS will take all necessary measures to alleviate these hazards should they arise.

### 3.3.1 Heat Stress

The combination of warm ambient temperature and protective clothing result in the potential for heat stress. Heat stress disorders include:

- Heat rash
- Heat cramps
- Heat exhaustion
- Heat stroke

Heat stress prevention is outlined in procedure No. 22 of the OHM Corp. LANTDIV Health and Safety Procedures manual. This information will be reviewed during safety meetings. Workers will be encouraged to increase consumption of water and electrolyte-containing beverages (e.g., Gatorade).

It is recommended that workers break approximately every 2 hours for 10 to 15 minute rest periods when temperatures rise above 72.5 degrees F. and protective clothing is worn. In addition, workers are encouraged to take rests whenever they feel any adverse effects that may be heat-related. The frequency of breaks may need to be increased upon worker recommendation to the SSO and SS. Heat stress can be prevented by assuring an adequate work/rest schedule; guidelines are printed below.

| AMBIENT TEMPERATURE | NO CHEMICAL PROTECTIVE CLOTHING (LEVEL D PPE) | CHEMICAL PROTECTIVE CLOTHING (D+/C/B/A) |
|---|---|---|
| 90° F or above | After 45 minutes of work | After 15 minutes of work |
| 87.5 F-90 F | After 60 minutes of work | After 30 minutes of work |
| 82.5-87.5 F | After 90 minutes of work | After 60 minutes of work |
| 77.5-82.5 F | After 120 minutes of work | After 90 minutes of work |
| 72.5-77.5 F | After 150 minutes of work | After 120 minutes of work |

The work/rest schedule can be calculated based on heat stress monitoring results. Monitoring consists of taking the radial pulse of a worker for 30 seconds immediately after exiting the work area. The frequency of monitoring is provided herein.

If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by ⅓ and keep the rest period the same. If the heart rate still exceeds 110 beats per minute at the next rest period, increase the following rest period by ⅓. The initial rest period should be at least 10 minutes.

Body temperature measured orally or through the ear canal may also be monitored to assess heat stress. Workers should not be permitted to continue work when their body temperature exceeds 100.4 F (38C). Monitoring should be conducted at the intervals given above.

Monitoring for heat stress will begin when the ambient temperature reaches or exceeds 70 degrees Fahrenheit when wearing chemical protective clothing, or 80 degrees Fahrenheit for site activities performed with no chemical protective clothing (Level D). Monitoring will include pulse rate, weight loss, oral temperature and signs and symptoms of heat stress. See Procedure 22 LANTDIV Health and Safety Procedures Manual.

### 3.3.2 Biological Hazards

- POISON IVY (*Rhus Radicans*)

  Poison Ivy may be found at the site. It is highly recommended that all personnel entering into an area with poison ivy wear a minimum of a tyvek coverall, to avoid skin contact.

  The majority of skin reactions following contact with offending plants are allergic in nature and characterized by:

- General symptoms of headache and fever
- Itching
- Redness
- A rash

Some of the most common and most severe allergic reactions result from contact with plants of the poison ivy group, including poison oak and poison sumac. Such plants produce severe rash characterized by redness, blisters, swelling, and intense burning and itching. The victim may develop a high fever and feel very ill. Ordinarily, the rash begins within a few hours after exposure, but may be delayed 24 to 48 hours.

Distinguishing Features of Poison Ivy Group Plants

The most distinctive features of poison ivy and poison oak are their leaves, which are composed of three leaflets each. Both plants have greenish-white flowers and berries that grow in clusters (see Figure 3.1).

First Aid

a. Remove contaminated clothing; wash all exposed areas thoroughly with soap and water, followed by rubbing alcohol.

b. Apply calamine or other soothing lotion if rash is mild. 1% hydrocortisone cream (over-the-counter) will aid in healing and reducing itch.

c. Seek medical advice if a severe reaction occurs, or if there is a known history of previous sensitivity.

- TICKS

Heavily vegetated areas of a site may have ticks. It is highly recommended that all personnel walking through such areas wear a tyvek coverall and latex boot covers taped at all joints. The ticks will stand out against the light colors. A tick or insect repellent containing DEET is recommended.

Ticks can transmit several diseases, including Rocky Mountain spotted fever, a disease that occurs in the eastern portion of the United States as well as the western portion, and Lyme disease. Ticks adhere tenaciously to the skin or scalp. There is some evidence that the longer an infected tick remains attached, the greater is the chance that it will transmit disease.

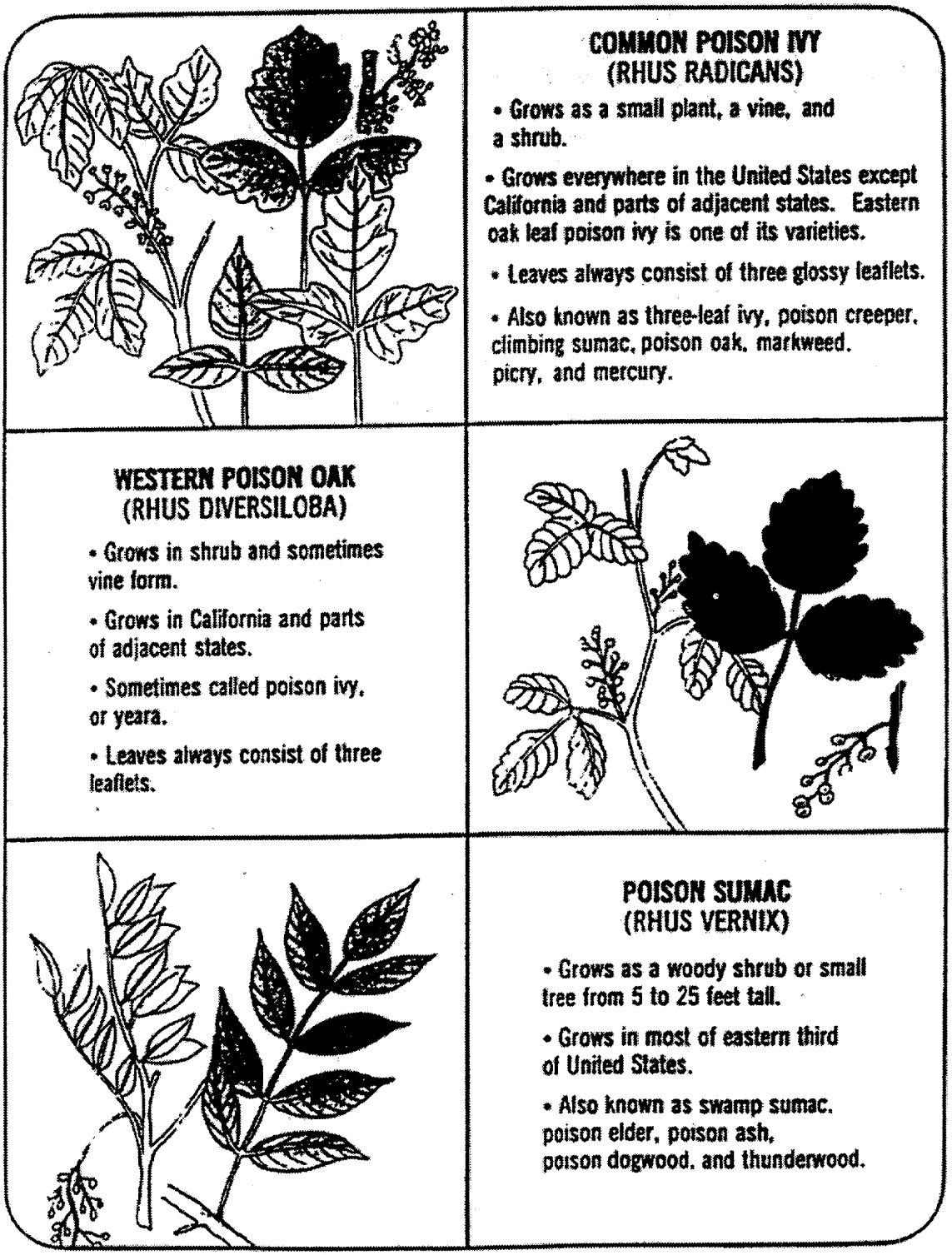
First Aid

a. Carefully (slowly and gently) remove the tick with tweezers, taking care that all parts are removed.

b. With soap and water, thoroughly, but gently, scrub the area from which the tick has been removed, because disease germs may be present on the skin; also wipe the bite area with an antiseptic.

c. If you have been bitten, place the tick in a jar labeled with the date, location of the bite, and the location acquired. If any symptom appears, such as an expanding red rash, contact a physician immediately.

**FIGURE 3.1**
**POISONOUS PLANTS**



- LYME DISEASE

Lyme disease may cause a number of medical conditions, including arthritis, that can be treated if you recognize the symptoms early and see your doctor. Early signs may include a flu-like illness, an expanding skin rash and joint pain. If left untreated, Lyme disease can cause serious nerve and heart problems as well as a disabling type of arthritis.

You are more likely to spot early signs of Lyme disease rather than see the tick or its bite. This is because the tick is so small (about the size of the head of a common pin or a period on this page and a little larger after they fill with blood), you may miss it or signs of a bite. However, it is also easy to miss the early symptoms of Lyme disease.

In its early stage, Lyme disease may be a mild illness with symptoms like the flu. It can include a stiff neck, chills, fever, sore throat, headache, fatigue, and joint pain. But this flu-like illness is usually out of season, commonly happening between May and October when ticks bite.

Most people develop a large, expanding skin rash around the area of the bite. Some people may get more than one rash. The rash may feel hot to the touch and may be painful. Rashes vary in size, shape, and color, but often look like a red ring with a clear center. The outer edges expand in size. Its easy to miss the rash and the connection between the rash and the tick bite. The rash develops from three days to as long as a month after the tick bite. Almost one third of those with Lyme disease never get the rash.

Joint or muscle pain may be another early sign of Lime disease. These aches and pains may be easy to confuse with the pain that comes from other types of arthritis. However, unlike many other types of arthritis, this pain seems to move or travel from joint to joint.

In later stages, Lyme disease may be confused with other medical problems. These problems can develop months to years after the first tick bite.

Early treatment of Lyme disease symptoms with antibiotics can prevent the more serious medical problems of later stages. If you suspect that you have symptoms of Lime disease, contact your doctor.

Lyme disease can cause problems with the nervous system that look like other diseases. These include symptoms of stiff neck, severe headache, and fatigue usually linked to meningitis. They may also include pain and drooping of the muscles on the face, called Bell's Palsy. Lyme disease can also mimic symptoms of multiple sclerosis or other types of paralysis.

Lyme disease can also cause serious but reversible heart problems, such as irregular heart beat. Finally, Lyme disease can result in a disabling, chronic type of arthritis that most often affects the knees. Treatment is more difficult and less successful in later stages. Researchers think these more serious problems may be linked to how the body's defense or immune system responds to the infection.

### 3.3.3 Noise

Hearing protection is required for workers operating or working near heavy equipment, where the noise level is greater than 85 dbA (TWA) as well as personnel working around heavy equipment. The SSO

will determine the need for and appropriate testing procedures, i.e., sound level meter and/or dosimeter for noise measurement.

## 3.4 TASK-SPECIFIC JOB SAFETY ANALYSES

This section of the Site-Specific HASP provides a breakdown of the hazards and control measures for each principal task. These Job Safety Analyses are general in nature and must be made project specific by the Site Supervisor prior to each task. The Job Safety Analyses will be field checked by the supervisor on an ongoing basis and revised as necessary. All revisions will be communicated to the work crew.

| 3.4.1 | JOB SAFETY ANALYSIS FOR SITE PREPARATION | | | |
|---|---|---|---|---|
| **AIR MONITORING: "ACTION LEVELS"<br>PID: <1 PPM, LEVEL D; ≥1 PPM <5 PPM, LEVEL C; >5 PPM LEVEL B<br>MINI-RAM: <0.25 MG/M³ LEVEL D; ≥ 0.25 MG/M³ <2.5 MG/M³, LEVEL C; >2.5 MG/M³, LEVEL B<br>LEL/$O_2$; ≥10% LEL, STOP WORK, EVACUATE; <20.9% $O_2$, LEVEL B; <19.5% $O_2$, MECHANICAL VENTILLATION, CONSTANT MONITORING** | | | | |
| **Task Breakdown** | **Potential Hazards** | **Hazard Control Measures** | **Personal Protective Equipment** | **Air Monitoring Devices** |
| Equipment/ Facility Set-up | Slips, Trips, Falls | • Clear walkways work areas of equipment, tools, vegetation, excavated material and debris<br>• Mark, identify, or barricade other obstructions | | |
| | Electrical Shock | • De-energize or shut off utility lines at their source before work begins<br>• Use double insulated or properly grounded electric power-operated tools<br>• Maintain tools in a safe condition<br>• Provide an equipment-grounding conductor program or employ ground-fault circuit interrupters<br>• Use qualified electricians to hook up electrical circuits<br>• Inspect all extension cords daily for structural integrity, ground continuity, and damaged insulation<br>• Cover or elevate electric wire or flexible cord passing through work areas to protect from damage<br>• Keep all plugs and receptacles out of water<br>• Use approved water-proof, weather-proof type if exposure to moisture is likely<br>• Inspect all electrical power circuits prior to commencing work<br>• Follow Lockout-Tagout procedures in accordance with OHM Health and Safety Procedures #38 | Insulated gloves | |
| | Handling Heavy Objects | • Observe proper lifting techniques<br>• Obey sensible lifting limits (60 lb. maximum per person manual lifting)<br>• Use mechanical lifting equipment (hand carts, trucks) to move large, awkward loads | | |

| 3.4.1 | JOB SAFETY ANALYSIS FOR SITE PREPARATION | | | |
|---|---|---|---|---|
| **AIR MONITORING: "ACTION LEVELS"<br>PID: <1 PPM, LEVEL D; ≥1 PPM <5 PPM, LEVEL C; >5 PPM LEVEL B<br>MINI-RAM: <0.25 MG/M³ LEVEL D; ≥ 0.25 MG/M³ <2.5 MG/M³, LEVEL C; >2.5 MG/M³, LEVEL B<br>LEL/$O_2$: ≥10% LEL, STOP WORK, EVACUATE; <20.9% $O_2$, LEVEL B; <19.5% $O_2$, MECHANICAL VENTILLATION, CONSTANT MONITORING** | | | | |
| **Task Breakdown** | **Potential Hazards** | **Hazard Control Measures** | **Personal Protective Equipment** | **Air Monitoring Devices** |
| Equipment/ Facility Set-up (Continued) | Sharp Objects | • Wear cut resistant work gloves when the possibility of lacerations or other injury may be caused by sharp edges or objects<br>• Maintain all hand and power tools in a safe condition<br>• Keep guards in place during use | Leather gloves, re-enforced palm | |
| | High Noise Levels | • Use hearing protection when exposed to excessive noise levels (greater than 85 dBA over an 8-hour work period) | Ear plugs | |
| | High Ambient Temperature | • Monitor for Heat stress in accordance with OHM Health and Safety Procedures # 22<br>• Provide fluids to prevent worker dehydration | | |

| 3.4.2 | JOB SAFETY ANALYSIS FOR CLEARING AND GRUBBING, TREE FELLING | | | |
|---|---|---|---|---|
| **AIR MONITORING: "ACTION LEVELS"<br>PID: <1 PPM, LEVEL D; ≥ 1 PPM <5 PPM, LEVEL C; >5 PPM LEVEL B<br>MINI-RAM: <0.25 MG/M³ LEVEL D; ≥ 0.25 MG/M³ <2.5 MG/M³, LEVEL C; >2.5 MG/M³, LEVEL B<br>LEL/$O_2$: ≥10% LEL, STOP WORK, EVACUATE; <20.9% $O_2$, LEVEL B; <19.5% $O_2$, MECHANICAL VENTILLATION, CONSTANT MONITORING** | | | | |
| **Task Breakdown** | **Potential Hazards** | **Hazard Control Measures** | **Personal Protective Equipment** | **Air Monitoring Devices** |
| Clearing, Grubbing | Struck By/ Against Heavy Equipment | • Use reflective warning vests worn when exposed to vehicular traffic<br>• Isolate equipment swing areas<br>• Make eye contact with operators before approaching equipment<br>• Understand and review hand signals | Warning vests, Hard hat, safety glasses | |
| | Slips, Trips, Falls | • Clear walkways, work areas of equipment, tools, vegetation, excavated material, and debris<br>• Mark, identify, or barricade other obstructions | | |
| | Handling Heavy Objects | • Observe proper lifting techniques<br>• Obey sensible lifting limits (60 lb. maximum per person manual lifting)<br>• Use mechanical lifting equipment (hand carts, trucks) to move large, awkward loads | | |
| | Eye Injuries | • Wear face shield, goggles when operating powered clearing / grubbing equipment | Face shield, goggles, Leather gloves, re-enforced palms | |
| | Sharp Objects | • Wear cut resistant work gloves when the possibility of lacerations or other injury may be caused by sharp edges or objects<br>• Maintain all hand and power tools in a safe condition<br>• Keep guards in place during use<br>• Close doors, windows on heavy equipment to prevent injuries from tree branches and other vegetation | Leather gloves, re-enforced palms | |

| 3.4.2 | JOB SAFETY ANALYSIS FOR CLEARING AND GRUBBING, TREE FELLING | | | |
|---|---|---|---|---|
| AIR MONITORING: "ACTION LEVELS"<br>PID: <1 PPM, LEVEL D; ≥1 PPM <5 PPM, LEVEL C; >5 PPM LEVEL B<br>MINI-RAM: <0.25 MG/M³ LEVEL D; ≥ 0.25 MG/M³ <2.5 MG/M³, LEVEL C; >2.5 MG/M³, LEVEL B<br>LEL/$O_2$: ≥10% LEL, STOP WORK, EVACUATE; <20.9% $O_2$, LEVEL B; <19.5% $O_2$, MECHANICAL VENTILLATION, CONSTANT MONITORING | | | | |
| **Task Breakdown** | **Potential Hazards** | **Hazard Control Measures** | **Personal Protective Equipment** | **Air Monitoring Devices** |
| Clearing, Grubbing (Continued) | Insect/ Snake Bites | • Review injury potential and types of snakes with workers<br>• Avoid insect nests areas, likely habitats of snakes outside work areas<br>• Emphasize The Buddy System where such injury potential exists<br>• Use insect repellant, wear PPE to protect against sting/bite injuries | Tyvek coveralls, duct tape bottom of coveralls to boots or latex boot covers | |
| | Contact Dermatitis | • Wear PPE to avoid skin contact with contaminated soil, plants, or other skin irritants (See Section 5.0 HASP)<br>• Identify and review poisonous plants with workers | Tyvek coveralls, duct tape bottom of coveralls to boots or latex boot covers | LEL/$O_2$, PID, Mini-RAM |
| | Operations of power clearing tools ( brush saws, weed wackers...) | • Wear eye, face, hand & hearing protection when operating power clearing equipment<br>• Shut-off / idle power tools walking between work areas<br>• Store flammable liquids in well ventilated areas, away from work areas<br>• Shut off equipment during re-fueling<br>• Prohibit smoking while operating clearing equipment<br>• Provide ABC (or equivalent) fire extinguishers for all work | Face shield, goggles, cloth gloves, ear plugs, | |
| | Operation of chippers | • Lockout/target/de-energize any electrical circuits on chippers before clearing/maintenance<br>• Identify staging area for debris<br>• Keep chipper approach free of ground debris<br>• Follow all precautions for operation of power cleaning tools | Insulated gloves | |
| | High Noise Levels | • Use hearing protection when exposed to excessive noise levels (greater than 85 dBA over an 8-hour work period) | Ear plugs | |

| 3.4.2 | JOB SAFETY ANALYSIS FOR CLEARING AND GRUBBING, TREE FELLING | | | |
|---|---|---|---|---|
| **AIR MONITORING: "ACTION LEVELS"**<br>**PID: <1 PPM, LEVEL D; ≥1 PPM <5 PPM, LEVEL C; >5 PPM LEVEL B**<br>**MINI-RAM: <0.25 MG/M³ LEVEL D; ≥ 0.25 MG/M³ <2.5 MG/M³, LEVEL C; >2.5 MG/M³, LEVEL B**<br>**LEL/$O_2$: ≥10% LEL, STOP WORK, EVACUATE; <20.9% $O_2$, LEVEL B; <19.5% $O_2$, MECHANICAL VENTILLATION, CONSTANT MONITORING** | | | | |
| **Task Breakdown** | **Potential Hazards** | **Hazard Control Measures** | **Personal Protective Equipment** | **Air Monitoring Devices** |
| Clearing, Grubbing (Continued) | High Ambient Temperature | • Monitor for Heat stress in accordance with OHM Health and Safety Procedures # 22<br>• Provide fluids to prevent worker dehydration | | |
| Tree Felling; Chippers, Chainsaws | Fires | • Eliminate sources of ignition from the work area<br>• Prohibit Smoking<br>• Provide ABC (or equivalent) fire extinguishers for all flammable storage areas, powered cutting equipment re-fueling areas, fuel powered generators and compressors<br>• Store flammable liquids in well ventilated areas<br>• Prohibit storage, transfer of flammable liquids in plastic containers<br>• Enforce use of approved flammable liquid safety cans<br>• Post "NO SMOKING" signs<br>• Store combustible materials away from flammables<br>• Allow chainsaw to cool off before re-fueling<br>• Prohibit chainsaw startup in re-fueling areas | | |
| | Slips, Trips, Falls | • Clear walkways, work areas of equipment, tools, vegetation, excavated material, and debris<br>• Mark, identify, or barricade other obstructions<br>• Ensure safe footing before starting chainsaws | | |
| | Sharp Objects | • Wear cut resistant work gloves when the possibility of lacerations or other injury may be caused by sharp edges or objects<br>• Prohibit handling, touching chain blade while chainsaw is operating<br>• Maintain all hand and power tools in a safe condition<br>• Keep guards in place during use | Leather gloves, re-enforced palms | |

| 3.4.2 | JOB SAFETY ANALYSIS FOR CLEARING AND GRUBBING, TREE FELLING | | | |
|---|---|---|---|---|
| **AIR MONITORING: "ACTION LEVELS"<br>PID: <1 PPM, LEVEL D; ≥1 PPM <5 PPM, LEVEL C; >5 PPM LEVEL B<br>MINI-RAM: <0.25 MG/M³ LEVEL D; ≥ 0.25 MG/M³ <2.5 MG/M³, LEVEL C; >2.5 MG/M³, LEVEL B<br>LEL/$O_2$: ≥10% LEL, STOP WORK, EVACUATE; <20.9% $O_2$, LEVEL B; <19.5% $O_2$, MECHANICAL VENTILLATION, CONSTANT MONITORING** | | | | |
| **Task Breakdown** | **Potential Hazards** | **Hazard Control Measures** | **Personal Protective Equipment** | **Air Monitoring Devices** |
| Tree Felling; Chippers, Chainsaws *(Continued)* | Kickback | • Maintain both hands on chainsaw while cutting<br>• Avoid cutting actions that may pinch the chain blade<br>• Idle or shut down chainsaw when walking any distance<br>• Operate chainsaws only at 'full' power when cutting<br>• Prohibit use of defective chainsaws | | |
| | Struck By/ Against Heavy Equipment, Falling Objects, Flying Debris | • Use reflective warning vests worn when exposed to vehicular traffic<br>• Wear face protection to avoid facial injury from flying chain debris<br>• Isolate equipment operation, tree felling areas (2 ½ tree lengths)<br>• Make eye contact with (chainsaw) operators before approaching<br>• Inspect tree for dead, broken limbs before cutting<br>• Prohibit cutting overhead, above shoulder height<br>• Understand and review hand signals | Warning vests, Hard hat, safety goggles and face shield | |
| | Burns | • Wear proper PPE for protection from hot motor parts, muffler<br>• Shut down equipment during re-fueling<br>• Do not allow fuel to contact hot parts of equipment, will start fire | Leather gloves, apron | |
| | Caught by/between | • Prohibit standing on, straddling logs while ground cutting<br>• Stand uphill while ground cutting<br>• Start relieving cuts on compression side of log first, then make bucking cut on tension side<br>• Prohibit workers from holding logs while being cut<br>• Stop saw motor to remove saw if pinched | | |

| 3.4.2 | JOB SAFETY ANALYSIS FOR CLEARING AND GRUBBING, TREE FELLING | | | |
|---|---|---|---|---|
| AIR MONITORING: "ACTION LEVELS"<br>PID: <1 PPM, LEVEL D; ≥1 PPM <5 PPM, LEVEL C; >5 PPM LEVEL B<br>MINI-RAM: <0.25 MG/M$^3$ LEVEL D; ≥ 0.25 MG/M$^3$ <2.5 MG/M$^3$, LEVEL C; >2.5 MG/M$^3$, LEVEL B<br>LEL/$O_2$: ≥10% LEL, STOP WORK, EVACUATE; <20.9% $O_2$, LEVEL B; <19.5% $O_2$, MECHANICAL VENTILLATION, CONSTANT MONITORING | | | | |
| **Task Breakdown** | **Potential Hazards** | **Hazard Control Measures** | **Personal Protective Equipment** | **Air Monitoring Devices** |
| Tree Felling; Chippers, Chainsaws (Continued) | Handling Heavy Objects | • Observe proper lifting techniques<br>• Obey sensible lifting limits (60 lb. maximum per person manual lifting)<br>• Use mechanical lifting equipment (hand carts, trucks) to move large, awkward loads | | |
| | Insect Bites | • Review injury potential with workers<br>• Avoid insect nests areas, likely habitats outside work areas<br>• Emphasize The Buddy System where such injury potential exists<br>• Use insect repellant, wear PPE to protect against sting/bite injuries. | Tyvek coveralls, duct tape bottom of coveralls to boots or latex boot covers | |
| | Contact Dermatitis | • Wear PPE to avoid skin contact with contaminated soil, plants, or other skin irritants<br>• Identify and review poisonous plants with workers | Tyvek coveralls, duct tape bottom of coveralls to boots or latex boot covers (See Section 5.0 HASP) | |
| | High Noise Levels | • Use hearing protection when exposed to excessive noise levels (greater than 85 dBA over an 8-hour work period) | Ear plugs | |
| | High Ambient Temperature | • Monitor for Heat stress in accordance with OHM Health and Safety Procedures # 22<br>• Provide fluids to prevent worker dehydration | | |

| 3.4.3 | JOB SAFETY ANALYSIS FOR EROSION CONTROL INSTALLATION | | | |
|---|---|---|---|---|
| **AIR MONITORING: "ACTION LEVELS"<br>PID: <1 PPM, LEVEL D; ≥1 PPM <5 PPM, LEVEL C; >5 PPM LEVEL B<br>MINI-RAM: <0.25 MG/M³ LEVEL D; ≥ 0.25 MG/M³ <2.5 MG/M³, LEVEL C; >2.5 MG/M³, LEVEL B<br>LEL/$O_2$: ≥10% LEL, STOP WORK, EVACUATE; <20.9% $O_2$, LEVEL B; <19.5% $O_2$, MECHANICAL VENTILATION, CONSTANT MONITORING** | | | | |
| **Task Breakdown** | **Potential Hazards** | **Hazard Control Measures** | **Personal Protective Equipment** | **Air Monitoring Devices** |
| Silt Fence, Hay Bale Installation | Slips, Trips, Falls | • Clear walkways, work areas of equipment, tools and debris<br>• Mark, identify, or barricade other obstructions | | |
| | Handling Heavy Objects | • Observe proper lifting techniques<br>• Obey sensible lifting limits (60 lb. maximum per person manual lifting)<br>• Use mechanical lifting equipment (hand carts, trucks) to move large, awkward loads | | |
| | Struck/ Struck-by Hand Tools, Flying Debris | • Hold stakes in place with tongs, vice-pliers or other remote grasping tools<br>• Wear safety goggles when using sledge hammer, hatchet, maul or axe | Leather gloves, re-enforced palms, face shield and goggles | |
| | Sharp Objects | • Wear cut resistant work gloves when the possibility of lacerations or other injury may be caused by sharp edges or objects<br>• Maintain all hand and power tools in a safe condition<br>• Keep guards in place during use | Leather gloves, re-enforced palms | |
| | High Noise Levels | • Use hearing protection when exposed to excessive noise levels (greater than 85 dBA over an 8-hour work period) | Ear plugs | |
| | Contact Dermatitis | • Wear PPE to avoid skin contact with contaminated soil, plants, or other skin irritants (See Section 5.0 HASP)<br>• Identify and review poisonous plants with workers | Tyvek coveralls, duct tape bottom of coveralls to boots or latex boot covers | |
| | High Ambient Temperature | • Monitor for Heat stress in accordance with OHM Health and Safety Procedures # 22<br>• Provide fluids to prevent worker dehydration | | |

| 3.4.4 | JOB SAFETY ANALYSIS FOR SOIL EXCAVATION | | | |
|---|---|---|---|---|
| **AIR MONITORING: "ACTION LEVELS"**<br>**PID: <1 PPM, LEVEL D; ≥1 PPM <5 PPM, LEVEL C; >5 PPM LEVEL B**<br>**MINI-RAM: <0.25 MG/M³ LEVEL D; ≥ 0.25 MG/M³ <2.5 MG/M³, LEVEL C; >2.5 MG/M³, LEVEL B**<br>**LEL/$O_2$: ≥10% LEL, STOP WORK, EVACUATE; <20.9% $O_2$, LEVEL B; <19.5% $O_2$, MECHANICAL VENTILATION, CONSTANT MONITORING** | | | | |
| **Task Breakdown** | **Potential Hazards** | **Hazard Control Measures** | **Personal Protective Equipment** | **Air Monitoring Devices** |
| Excavation of Soil | Underground Utilities | • Identify all underground utilities around the excavation site before work commences<br>• Cease work immediately if unknown utility markers are uncovered | | |
| | Struck By/ Against Heavy Equipment | • Use reflective warning vests when exposed to vehicular traffic<br>• Isolate equipment swing areas<br>• Make eye contact with operators before approaching equipment<br>• Understand and review hand signals | Warning vests, hard hat, safety glasses | |
| | Fires/Flash | • Apply water spray to soil and excavator bucket during excavation<br>• Keep soil wet during excavation and truck loadout | | |
| | Sharp Objects | • Wear cut resistant work gloves when the possibility of lacerations or other injury may be caused by sharp edges or objects<br>• Maintain all hand and power tools in a safe condition<br>• Keep guards in place during use | Leather gloves, re-enforced palm | |
| | High Noise Levels | • Use hearing protection when exposed to excessive noise levels (greater than 85 dBA over an 8-hour work period) | Ear plugs | |

| 3.4.4 | JOB SAFETY ANALYSIS FOR SOIL EXCAVATION | | | |
|---|---|---|---|---|
| **AIR MONITORING: "ACTION LEVELS"<br>PID: <1 PPM, LEVEL D; ≥1 PPM <5 PPM, LEVEL C; >5 PPM LEVEL B<br>MINI-RAM: <0.25 MG/M³ LEVEL D; ≥ 0.25 MG/M³ <2.5 MG/M³, LEVEL C; >2.5 MG/M³, LEVEL B<br>LEL/$O_2$: ≥10% LEL, STOP WORK, EVACUATE; <20.9% $O_2$, LEVEL B; <19.5% $O_2$, MECHANICAL VENTILATION, CONSTANT MONITORING** | | | | |
| **Task Breakdown** | **Potential Hazards** | **Hazard Control Measures** | **Personal Protective Equipment** | **Air Monitoring Devices** |
| Excavation of Soil (Continued) | Excavation Wall Collapse | • Construct diversion ditches or dikes to prevent surface water from entering excavation<br>• Provide good drainage of area adjacent to excavation<br>• Collect ground water/rain water from excavation and dispose of properly<br>• Store excavated material at least 2 feet from the edge of the excavation; prevent excessive loading of the excavation face<br>• Provide sufficient stairs, ladders, or ramps when workers enter excavations over 4 feet in depth<br>• Place ladders no more than 25 feet apart laterally<br>• Treat excavations over 4 feet deep as confined spaces<br>• Complete confined space permit entry procedure<br>• Monitor atmosphere for flammable/toxic vapors, and oxygen deficiency<br>• Slope, bench, shore, or sheet excavations over 5 feet deep if worker entry is required<br>• Assign a competent person to inspect, decide soil classification, proper sloping, the correct shoring, or sheeting<br>• Inspect excavations (when personnel entry is required) daily, any time conditions change<br>• Provide at least two means of exit for personnel working in excavations | Hard hat, safety glasses | |
| | Slips, Trips, Falls | • Clear walkways, work areas of equipment, vegetation, excavated material, tools, and debris<br>• Mark, identify, or barricade other obstructions | | |
| | Handling Heavy Objects | • Observe proper lifting techniques<br>• Obey sensible lifting limits (60 lb. maximum per person manual lifting)<br>• Use mechanical lifting equipment (hand carts, trucks) to move large, awkward loads | | |

| 3.4.4 | JOB SAFETY ANALYSIS FOR SOIL EXCAVATION | | | |
|---|---|---|---|---|
| **AIR MONITORING: "ACTION LEVELS"<br>PID: <1 PPM, LEVEL D; >1 PPM <5 PPM, LEVEL C; >5 PPM LEVEL B<br>MINI-RAM: <0.25 MG/M³ LEVEL D; ≥ 0.25 MG/M³ <2.5 MG/M³, LEVEL C; >2.5 MG/M³, LEVEL B<br>LEL/$O_2$: ≥10% LEL, STOP WORK, EVACUATE; <20.9% $O_2$, LEVEL B; <19.5% $O_2$, MECHANICAL VENTILATION, CONSTANT MONITORING** | | | | |
| **Task Breakdown** | **Potential Hazards** | **Hazard Control Measures** | **Personal Protective Equipment** | **Air Monitoring Devices** |
| Excavation of Soil (Continued) | Inhalation and Contact with Hazardous Substances | • Provide workers proper skin, eye and respiratory protection based on the exposure hazards present<br>• Review hazardous properties of site contaminants with workers before operations begin<br>• Dampen soil using light water spray to prevent fugitive dust emissions<br>• Cover stockpiled soil with plastic sheeting to prevent fugitive dust emissions | Tyvek coveralls, latex gloves, neoprene or latex boots (See Section 5.0 HASP) | LEL/$O_2$, PID, Mini-RAM |
| | High Ambient Temperature | • Monitor for Heat stress in accordance with OHM Health and Safety Procedures # 22<br>• Provide fluids to prevent worker dehydration | | |
| Backfilling | Slips, Trips, Falls | • Clear walkways, work areas of equipment, vegetation, excavated material, tools, and debris<br>• Mark, identify, or barricade other obstructions | | |
| | Struck By/ Against Heavy Equipment | • Use reflective warning vests worn when exposed to vehicular traffic<br>• Isolate equipment swing areas<br>• Make eye contact with operators before approaching equipment<br>• Understand and review hand signals | Warning vests, hard hat safety glasses | |
| | Sharp Objects | • Wear cut resistant work gloves when the possibility of lacerations or other injury may be caused by sharp edges or objects<br>• Maintain all hand and power tools in a safe condition<br>• Keep guards in place during use | Leather gloves re-enforced palms | |

| 3.4.5 | JOB SAFETY ANALYSIS FOR BIOCELL CONSTRUCTION |
|---|---|

**AIR MONITORING: "ACTION LEVELS"**
**PID: <1 PPM, LEVEL D; ≥1 PPM <5 PPM, LEVEL C; >5 PPM LEVEL B**
**MINI-RAM: <0.25 MG/M³ LEVEL D; ≥ 0.25 MG/M³ <2.5 MG/M³, LEVEL C; >2.5 MG/M³, LEVEL B**
**LEL/$O_2$: ≥10% LEL, STOP WORK, EVACUATE; <20.9% $O_2$, LEVEL B; <19.5% $O_2$, MECHANICAL VENTILATION, CONSTANT MONITORING**

| Task Breakdown | Potential Hazards | Hazard Control Measures | Personal Protective Equipment | Air Monitoring Devices |
|---|---|---|---|---|
| Biocell Construction | Slips, Trips, Falls | • Clear walkways, work areas of equipment, tools, construction debris and other materials<br>• Mark, identify, or barricade other obstructions | | |
| | Sprains and Strains | • Observe proper lifting techniques<br>• Obey sensible lifting limits (60 lb. maximum per person manual lifting)<br>• Use mechanical lifting equipment (hand carts, trucks) to move large, awkward loads<br>• Control pulling, placement of sludge bed liner materials<br>• Prohibit running, jumping during placement of liner materials | | |
| | Struck by, Against Heavy Equipment, Flying Debris, Protruding Objects | • Use reflective warning vests when exposed to vehicular traffic<br>• Isolate equipment swing areas<br>• Make eye contact with operators before approaching equipment<br>• Barricade or enclose the work area<br>• Restrict work area entry to authorized personnel only during construction activities<br>• Wear hard hats, safety glasses with side shields, and steel-toe safety boots<br>• Understand and review hand signals | Warning vests, Hard-hat, Safety glasses | |

| 3.4.5 | JOB SAFETY ANALYSIS FOR BIOCELL CONSTRUCTION | | | |
|---|---|---|---|---|
| **AIR MONITORING: "ACTION LEVELS"<br>PID: <1 PPM, LEVEL D; ≥1 PPM <5 PPM, LEVEL C; >5 PPM LEVEL B<br>MINI-RAM: <0.25 MG/M³ LEVEL D; ≥ 0.25 MG/M³ <2.5 MG/M³, LEVEL C; >2.5 MG/M³, LEVEL B<br>LEL/$O_2$: ≥10% LEL, STOP WORK, EVACUATE; <20.9% $O_2$, LEVEL B; <19.5% $O_2$, MECHANICAL VENTILATION, CONSTANT MONITORING** | | | | |
| **Task Breakdown** | **Potential Hazards** | **Hazard Control Measures** | **Personal Protective Equipment** | **Air Monitoring Devices** |
| Biocell Construction (Continued) | Biocell Wall Collapse | • Construct diversion ditches or dikes to prevent surface water from entering excavation<br>• Provide good drainage of area adjacent to excavation<br>• Collect ground water/rain water from excavation and dispose of properly<br>• Store excavated material at least 2 feet from the edge of the excavation; prevent excessive loading of the excavation face<br>• Provide sufficient stairs, ladders, or ramps when workers enter excavations over 4 feet in depth<br>• Place ladders no more than 25 feet apart laterally<br>• Treat excavations over 4 feet deep as confined spaces<br>• Complete confined space permit entry procedure<br>• Monitor atmosphere for flammable/toxic vapors, and oxygen deficiency<br>• Slope, bench, shore, or sheet excavations over 5 feet deep if worker entry is required<br>• Assign a competent person to inspect, decide soil classification, proper sloping, the correct shoring, or sheeting<br>• Inspect excavations (when personnel entry is required) daily, any time conditions change<br>• Provide at least two means of exit for personnel working in excavations | Hard hat, safety glasses | |
| | Sharp Objects | • Wear cut resistant work gloves when the possibility of lacerations or other injury may be caused by sharp edges or objects<br>• Maintain all hand and power tools in a safe condition<br>• Keep guards in place during use | Leather gloves re-enforced palms | |

| 3.4.5 | JOB SAFETY ANALYSIS FOR BIOCELL CONSTRUCTION | | | |
|---|---|---|---|---|
| **AIR MONITORING: "ACTION LEVELS"<br>PID: <1 PPM, LEVEL D; ≥1 PPM <5 PPM, LEVEL C; >5 PPM LEVEL B<br>MINI-RAM: <0.25 MG/M³ LEVEL D; ≥ 0.25 MG/M³ <2.5 MG/M³, LEVEL C; >2.5 MG/M³, LEVEL B<br>LEL/$O_2$: ≥10% LEL, STOP WORK, EVACUATE; <20.9% $O_2$, LEVEL B; <19.5% $O_2$, MECHANICAL VENTILATION, CONSTANT MONITORING** | | | | |
| **Task Breakdown** | **Potential Hazards** | **Hazard Control Measures** | **Personal Protective Equipment** | **Air Monitoring Devices** |
| Biocell Construction (Continued) | Handling Heavy Objects | • Observe proper lifting techniques<br>• Obey sensible lifting limits (60 lb. maximum per person manual lifting)<br>• Use mechanical lifting equipment (hand carts, trucks) to move large, awkward loads | | |
| | High Noise Levels | • Use hearing protection when exposed to excessive noise levels (greater than 85 dBA over an 8-hour work period) | Ear plugs | |
| | Caught In/ Between Moving Parts | • Identify and understand parts of equipment which may cause crushing, pinching, rotating or similar motions<br>• Assure guards are in place to protect from these parts of equipment during operation<br>• Provide and use proper work gloves when the possibility of pinching, or other injury may be caused by moving/ handling large or heavy objects<br>• Maintain all equipment in a safe condition<br>• Keep all guards in place during use<br>• De-energize and lock-out machinery before maintenance or service | | |
| | High Ambient Temperature | • Monitor for Heat stress in accordance with OHM Health and Safety Procedures # 22<br>• Provide fluids to prevent worker dehydration | | |

| 3.4.6 | JOB SAFETY ANALYSIS FOR DECONTAMINATION PAD CONSTRUCTION | | | |
|---|---|---|---|---|
| **AIR MONITORING: "ACTION LEVELS"<br>PID: <1 PPM, LEVEL D; ≥1 PPM <5 PPM, LEVEL C; >5 PPM LEVEL B<br>MINI-RAM: <0.25 MG/M³ LEVEL D; ≥ 0.25 MG/M³ <2.5 MG/M³, LEVEL C; >2.5 MG/M³, LEVEL B<br>LEL/$O_2$: ≥10% LEL, STOP WORK, EVACUATE; <20.9% $O_2$, LEVEL B; <19.5% $O_2$, MECHANICAL VENTILATION, CONSTANT MONITORING** | | | | |
| **Task Breakdown** | **Potential Hazards** | **Hazard Control Measures** | **Personal Protective Equipment** | **Air Monitoring Devices** |
| Concrete Pad Formation | Slips, Trips, Falls | • Clear walkways, work areas of equipment, tools, debris, and excavated material<br>• Mark, identify, or barricade other obstructions | | |
| | Struck by, Against Heavy Equipment, Flying Debris, Protruding Objects | • Use reflective warning vests when exposed to vehicular traffic<br>• Isolate equipment swing areas<br>• Isolate areas under suspended loads<br>• Make eye contact with operators before approaching equipment<br>• Barricade or enclose the work area<br>• Restrict entry to the work area to authorized personnel during concrete pouring activities<br>• Wear hard hats, safety glasses with side shields, and steel-toe safety boots at all times<br>• Understand and review hand signals | Warning vests, hard hat, safety glasses | |
| | Inhalation and Contact with Concrete Dust | • Apply water spray to eliminate dust<br>• Prevent skin and eye contact with concrete<br>• Use dust mask if conditions are dusty<br>• Review hazardous properties of site contaminants with workers before operations begin | Safety glasses | |

| 3.4.7 | JOB SAFETY ANALYSIS FOR OVERHEAD CRANE CONSTRUCTION | | | |
|---|---|---|---|---|
| **AIR MONITORING: "ACTION LEVELS"**<br>**PID: <1 PPM, LEVEL D; ≥1 PPM <5 PPM, LEVEL C; >5 PPM LEVEL B**<br>**MINI-RAM: <0.25 MG/M³ LEVEL D; ≥ 0.25 MG/M³ <2.5 MG/M³, LEVEL C; >2.5 MG/M³, LEVEL B**<br>**LEL/$O_2$: ≥10% LEL, STOP WORK, EVACUATE; <20.9% $O_2$, LEVEL B; <19.5% $O_2$, MECHANICAL VENTILATION, CONSTANT MONITORING** | | | | |
| **Task Breakdown** | **Potential Hazards** | **Hazard Control Measures** | **Personal Protective Equipment** | **Air Monitoring Devices** |
| Concrete Footer Formation | Slips, Trips, Falls | • Clear walkways, work areas of equipment, tools, debris, and excavated material<br>• Mark, identify, or barricade other obstructions | | |
| | Struck by, Against Heavy Equipment, Flying Debris, Protruding Objects | • Use reflective warning vests when exposed to vehicular traffic<br>• Isolate equipment swing areas<br>• Isolate areas under suspended loads<br>• Make eye contact with operators before approaching equipment<br>• Barricade or enclose the work area<br>• Restrict entry to the work area to authorized personnel during concrete pouring activities<br>• Wear hard hats, safety glasses with side shields, and steel-toe safety boots at all times<br>• Understand and review hand signals | Warning vests, hard hat, safety glasses | |
| | Inhalation and Contact with Concrete Dust | • Apply water spray to eliminate dust<br>• Prevent skin and eye contact with concrete<br>• Use dust mask if conditions are dusty<br>• Review hazardous properties of site contaminants with workers before operations begin | Safety glasses | |

| 3.4.7 | JOB SAFETY ANALYSIS FOR OVERHEAD CRANE CONSTRUCTION | | | |
|---|---|---|---|---|
| **AIR MONITORING: "ACTION LEVELS"<br>PID: <1 PPM, LEVEL D; ≥1 PPM <5 PPM, LEVEL C; >5 PPM LEVEL B<br>MINI-RAM: <0.25 MG/M³ LEVEL D; ≥ 0.25 MG/M³ <2.5 MG/M³, LEVEL C; >2.5 MG/M³, LEVEL B<br>LEL/$O_2$: ≥10% LEL, STOP WORK, EVACUATE; <20.9% $O_2$, LEVEL B; <19.5% $O_2$, MECHANICAL VENTILATION, CONSTANT MONITORING** | | | | |
| **Task Breakdown** | **Potential Hazards** | **Hazard Control Measures** | **Personal Protective Equipment** | **Air Monitoring Devices** |
| Gantry Crane Construction | Struck by, Against Heavy Equipment, Flying Debris, Protruding Objects | • Use reflective warning vests when exposed to vehicular traffic<br>• Isolate equipment swing areas<br>• Make eye contact with operators before approaching equipment<br>• Barricade or enclose the construction area<br>• Restrict entry to the work area to authorized personnel during construction activities<br>• Wear hard hats, safety glasses with side shields, and steel-toe safety boots<br>• Understand and review hand signals | Warning vests, hard hat, safety glasses | |
| | Slips, Trips, Falls | • Clear walkways, work areas of equipment, tools, construction debris, and other materials<br>• Mark, identify, or barricade other obstructions<br>• Use body harness and lifeline when working 10 feet or more above the ground<br>• Install/use fall restraints working at roof lines<br>• Use Approved ladders in accordance with OHM Health & Safety Procedure # 37<br>• Halt roof, exterior scaffold work in high winds, severe weather | Body harness, lifeline | |
| | Handling Heavy Objects | • Observe proper lifting techniques<br>• Obey sensible lifting limits (60 lb. maximum per person manual lifting)<br>• Use mechanical lifting equipment (hand carts, trucks) to move large, awkward loads | | |

| 3.4.7 | JOB SAFETY ANALYSIS FOR OVERHEAD CRANE CONSTRUCTION | | | |
|---|---|---|---|---|
| **AIR MONITORING: "ACTION LEVELS"<br>PID: <1 PPM, LEVEL D; ≥1 PPM <5 PPM, LEVEL C; >5 PPM LEVEL B<br>MINI-RAM: <0.25 MG/M³ LEVEL D; ≥ 0.25 MG/M³ <2.5 MG/M³, LEVEL C; >2.5 MG/M³, LEVEL B<br>LEL/$O_2$: ≥10% LEL, STOP WORK, EVACUATE; <20.9% $O_2$, LEVEL B; <19.5% $O_2$, MECHANICAL VENTILATION, CONSTANT MONITORING** | | | | |
| **Task Breakdown** | **Potential Hazards** | **Hazard Control Measures** | **Personal Protective Equipment** | **Air Monitoring Devices** |
| Gantry Crane Construction (Continued) | Caught In/ Between Moving Parts | • Identify and understand parts of equipment which may cause crushing, pinching, rotating or similar motions<br>• Assure guards are in place to protect from these parts of equipment during operation<br>• Provide and use proper work gloves when the possibility of pinching, or other injury may be caused by moving/ handling large or heavy objects<br>• Maintain all equipment in a safe condition<br>• Keep all guards in place during use<br>• De-energize and lock-out machinery before maintenance or service | Leather gloves re-enforced palms | |
| | High Noise Levels | • Use hearing protection when exposed to excessive noise levels (greater than 85 dBA over an 8-hour work period) | Ear plugs | |

| 3.4.7 | JOB SAFETY ANALYSIS FOR OVERHEAD CRANE CONSTRUCTION | | | |
|---|---|---|---|---|
| **AIR MONITORING: "ACTION LEVELS"<br>PID: <1 PPM, LEVEL D; ≥1 PPM <5 PPM, LEVEL C; >5 PPM LEVEL B<br>MINI-RAM: <0.25 MG/M³ LEVEL D; ≥ 0.25 MG/M³ <2.5 MG/M³, LEVEL C; >2.5 MG/M³, LEVEL B<br>LEL/$O_2$: ≥10% LEL, STOP WORK, EVACUATE; <20.9% $O_2$, LEVEL B; <19.5% $O_2$, MECHANICAL VENTILATION, CONSTANT MONITORING** | | | | |
| **Task Breakdown** | **Potential Hazards** | **Hazard Control Measures** | **Personal Protective Equipment** | **Air Monitoring Devices** |
| Gantry Crane Construction (Continued) | Electrical Shock | • De-energize or shut off utility lines at their source before work begins<br>• Use double insulated or properly grounded electric power-operated tools<br>• Maintain tools in a safe condition<br>• Provide an equipment-grounding conductor program or employ ground-fault circuit interrupters<br>• Use qualified electricians to hook up electrical circuits<br>• Inspect all extension cords daily for structural integrity, ground continuity, and damaged insulation<br>• Cover or elevate electric wire or flexible cord passing through work areas to protect from damage<br>• Keep all plugs and receptacles out of water<br>• Use approved water-proof, weather-proof type if exposure to moisture is likely<br>• Inspect all electrical power circuits prior to commencing work<br>• Follow Lockout-Tagout procedures in accordance with OHM Health and Safety Procedures #38 | | |
| | Structural Collapse | • Barricade or enclose the work areas<br>• Restrict entry to authorized personnel only during construction activities<br>• Wear hard hats, safety glasses with side shields, and steel-toe safety boots<br>• Understand and review hand signals | Hard hats, Safety glasses | |
| | High Ambient Temperature | • Monitor for Heat stress in accordance with OHM Health and Safety Procedures # 22<br>• Provide fluids to prevent worker dehydration | | |

| 3.4.8 | JOB SAFETY ANALYSIS FOR TRUCK LOADING AND HAULING OPERATIONS | | | |
|---|---|---|---|---|
| **AIR MONITORING: "ACTION LEVELS"<br>PID: <1 PPM, LEVEL D; ≥ 1 PPM <5 PPM, LEVEL C; >5 PPM LEVEL B<br>MINI-RAM: <0.25 MG/M³ LEVEL D; ≥ 0.25 MG/M³ <2.5 MG/M³, LEVEL C; >2.5 MG/M³, LEVEL B<br>LEL/$O_2$: ≥10% LEL, STOP WORK, EVACUATE; <20.9% $O_2$, LEVEL B; <19.5% $O_2$, MECHANICAL VENTILATION, CONSTANT MONITORING** | | | | |
| **Task Breakdown** | **Potential Hazards** | **Hazard Control Measures** | **Personal Protective Equipment** | **Air Monitoring Devices** |
| Truck, Loading and Unloading | Struck By/ Against Heavy Equipment | • Use reflective warning vests worn when exposed to vehicular traffic<br>• Obey posted speed limits<br>• Isolate equipment swing areas<br>• Make eye contact with operators before approaching equipment<br>• Understand and review hand signals | | |
| | Slips, Trips, Falls | • Clear walk ways, work areas of equipment, tools and debris<br>• Mark, identify, or barricade other obstructions | | |
| | Sharp Objects | • Wear cut resistant work gloves when the possibility of lacerations or other injury may be caused by sharp edges or objects<br>• Maintain all hand and power tools in a safe condition<br>• Keep guards in place during use | Leather gloves, re-enforced palms | |
| | High Noise Levels | • Use hearing protection when exposed to excessive noise levels (greater than 85 dBA over an 8-hour work period) | Ear plugs | |
| | Inhalation and Contact with Hazardous Substances | • Provide workers proper skin, eye and respiratory protection based on the exposure hazards present<br>• Review hazardous properties of site contaminants with workers before operations begin<br>• Dampen soil using light water spray to prevent fugitive dust emissions<br>• Cover stockpiled soil with plastic sheeting to prevent fugitive dust emissions | Tyvek coveralls, nitrile gloves, neoprene or latex boots (See Section 5.0 HASP) | PID, Mini-RAM |

| 3.4.8 | JOB SAFETY ANALYSIS FOR TRUCK LOADING AND HAULING OPERATIONS | | | |
|---|---|---|---|---|
| **AIR MONITORING: "ACTION LEVELS"<br>PID: <1 PPM, LEVEL D; ≥1 PPM <5 PPM, LEVEL C; >5 PPM LEVEL B<br>MINI-RAM: <0.25 MG/M³ LEVEL D; ≥ 0.25 MG/M³ <2.5 MG/M³, LEVEL C; >2.5 MG/M³, LEVEL B<br>LEL/$O_2$: ≥10% LEL, STOP WORK, EVACUATE; <20.9% $O_2$, LEVEL B; <19.5% $O_2$, MECHANICAL VENTILATION, CONSTANT MONITORING** | | | | |
| **Task Breakdown** | **Potential Hazards** | **Hazard Control Measures** | **Personal Protective Equipment** | **Air Monitoring Devices** |
| Truck, Loading and Unloading (Continued) | Caught In/ Between Moving Parts | • Identify and understand parts of equipment which may cause crushing, pinching, rotating or similar motions<br>• Assure guards are in place to protect from these parts of equipment during operation<br>• Provide and use proper work gloves when the possibility of pinching, or other injury may be caused by moving/ handling large or heavy objects<br>• Maintain all equipment in a safe condition<br>• Keep all guards in place during use<br>• Avoid moving hydraulic, dump or loading equipment | | |
| | Handling Heavy Objects | • Observe proper lifting techniques<br>• Obey sensible lifting limits (60 lb. maximum per person manual lifting)<br>• Use mechanical lifting equipment (hand carts, trucks) to move large, awkward loads | | |
| | High Ambient Temperature | • Monitor for Heat stress in accordance with OHM Health and Safety Procedures # 22<br>• Provide fluids to prevent worker dehydration | | |

| 3.4.9 | JOB SAFETY ANALYSIS FOR EQUIPMENT DECONTAMINATION | | | |
|---|---|---|---|---|
| **AIR MONITORING: "ACTION LEVELS"<br>PID: <1 PPM, LEVEL D; ≥1 PPM <5 PPM, LEVEL C; >5 PPM LEVEL B<br>MINI-RAM: <0.25 MG/M³ LEVEL D; ≥ 0.25 MG/M³ <2.5 MG/M³, LEVEL C; >2.5 MG/M³, LEVEL B<br>LEL/$O_2$: ≥10% LEL, STOP WORK, EVACUATE; <20.9% $O_2$, LEVEL B; <19.5% $O_2$, MECHANICAL VENTELATION, CONSTANT MONITORING** | | | | |
| **Task Breakdown** | **Potential Hazards** | **Hazard Control Measures** | **Personal Protective Equipment** | **Air Monitoring Devices** |
| Heavy Equipment & Vehicles | Slips, Trips, Falls | • Clear walkways, work areas of equipment, vegetation, tools and debris<br>• Mark, identify, or barricade other obstructions | | |
| | Struck by, Against Heavy Equipment, Protruding Objects, & Splashes | • Use reflective warning vests when exposed to vehicular traffic<br>• Isolate equipment swing areas<br>• Make eye contact with operators before approaching equipment<br>• Wear hard hats, safety glasses with side shields, or goggles with splash shields and steel-toe safety boots<br>• Understand and review hand signals | Warning vests hard hat safety glasses, goggles and face shield | |
| | Inhalation and Contact with Hazardous Substances | • Provide workers proper skin, eye and respiratory protection based on the exposure hazards present<br>• Review hazardous properties of site contaminants with workers before operations begin | PVC rain suit or Tyvek coveralls, nitrile gloves, neoprene or latex boots (See Section 5.0 HASP) | |
| | Burns | • Use proper gloves, face shield/safety goggles, shin and toe guards, and splash suits to protect workers from skin burns and injury when operating laser (high pressure washers) | Goggles and face shield, shin and toe guards, splash, rain suit | |
| | Handling Heavy Objects | • Observe proper lifting techniques<br>• Obey sensible lifting limits (60 lb. maximum per person manual lifting)<br>• Use mechanical lifting equipment (hand carts, trucks) to move large, awkward loads | | |
| | Sharp Objects | • Wear cut resistant work gloves when the possibility of lacerations or other injury may be caused by sharp edges or objects<br>• Maintain all hand and power tools in a safe condition<br>• Keep guards in place during use | Leather gloves re-enforced palms | |

| 3.4.9 | JOB SAFETY ANALYSIS FOR EQUIPMENT DECONTAMINATION | | | |
|---|---|---|---|---|
| **AIR MONITORING: "ACTION LEVELS"<br>PID: <1 PPM, LEVEL D; ≥1 PPM <5 PPM, LEVEL C; >5 PPM LEVEL B<br>MINI-RAM: <0.25 MG/M³ LEVEL D; ≥ 0.25 MG/M³ <2.5 MG/M³, LEVEL C; >2.5 MG/M³, LEVEL B<br>LEL/$O_2$: ≥10% LEL, STOP WORK, EVACUATE; <20.9% $O_2$, LEVEL B; <19.5% $O_2$, MECHANICAL VENTELATION, CONSTANT MONITORING** | | | | |
| **Task Breakdown** | **Potential Hazards** | **Hazard Control Measures** | **Personal Protective Equipment** | **Air Monitoring Devices** |
| Heavy Equipment & Vehicles (Continued) | High Noise Levels | • Use hearing protection when exposed to excessive noise levels (greater than 85 dBA over an 8-hour work period) | Ear plugs | |
| | High Ambient Temperature | • Monitor for Heat stress in accordance with OHM Health and Safety Procedures # 22<br>• Provide fluids to prevent worker dehydration | | |

| 3.4.10 | JOB SAFETY ANALYSIS FOR SITE RESTORATION | | | |
|---|---|---|---|---|
| AIR MONITORING: "ACTION LEVELS"<br>PID: <1 PPM, LEVEL D; ≥1 PPM <5 PPM, LEVEL C; >5 PPM LEVEL B<br>MINI-RAM: <0.25 MG/M³ LEVEL D; ≥ 0.25 MG/M³ <2.5 MG/M³, LEVEL C; >2.5 MG/M³, LEVEL B<br>LEL/$O_2$: ≥10% LEL, STOP WORK, EVACUATE; <20.9% $O_2$, LEVEL B; <19.5% $O_2$, MECHANICAL VENTELATION, CONSTANT MONITORING | | | | |
| **Task Breakdown** | **Potential Hazards** | **Hazard Control Measures** | **Personal Protective Equipment** | **Air Monitorng Devices** |
| Site Restoration | Struck by, Against Heavy Equipment, Protruding Objects | • Use reflective warning vests when exposed to vehicular traffic<br>• Avoid equipment swing areas<br>• Make eye contact with operators before approaching equipment<br>• Wear hard hats, safety glasses with side shields, or splash/face shields and goggles, and steel-toe safety boots at all times<br>• Understand and review hand signals | Warning vests, Hard-hat, Safety glasses | |
| | Slips, Trips, Falls | • Clear, walkways of equipment, tools, debris, other materials<br>• Mark, identify, or barricade other obstructions | | |
| | High Noise Levels | • Use hearing protection when exposed to excessive noise levels (greater than 85 dBA over an 8-hour work period) | Ear plugs | |
| | Handling Heavy Objects | • Observe proper lifting techniques<br>• Obey sensible lifting limits (60 lb per person for manual lifting)<br>• Use mechanical lifting equipment (hand carts, trucks) to move large, awkward loads | | |
| | Contact Dermatitis | • Wear PPE to avoid skin contact with contaminated soil, plants, or other skin irritants (See Section 5.0 HASP)<br>• Identify and review poisonous plants with workers | Tyvek coveralls, duct tape bottom of coveralls to boots or latex boot covers | |
| | High Ambient Temperature | • Monitor for Heat stress in accordance with OHM Health and Safety Procedures # 22<br>• Provide fluids to prevent worker dehydration | | |

## 3.5 ACCIDENT PREVENTION

This Site Specific Health and Safety Plan has been developed with accident prevention as the primary goal. Details are discussed throughout this SSHSP. This section will outline the Accident Prevention Plan established for this project.

### 3.5.1 Administrative Responsibilities

The Project Manager is ultimately responsible for the safety and health of site personnel. The PM is to provide the materials and maintenance of equipment necessary to enhance and maintain safe site and work conditions.

The SS has the responsibility and the authority to control the day to day remediation activities in the field with respect to safety. The SS reports directly to the Project Manager. The SS monitors employees for signs of heat stress, excessive fatigue, and obvious outward signs of chemical exposure. In addition, the SS ensures that equipment brought to the site is in proper working condition and inspected regularly. These responsibilities will be shared by the Site Foremen.

The Site Safety Officer reports to the Project Manager and the District Health and Safety Manager and is responsible to point out unsafe conditions that may pose a hazard to personnel or the public. The SSO is required to conduct regular safety inspections. Accident investigation will be performed by the SSO, and the SS, or both.

### 3.5.2 Phase Safety Plans (Job Safety Analyses)

Site-Specific Phase Safety Plans (Job Safety Analyses) will be developed for each contract activity and operation occurring in each major phase of work. The Phase Safety Plan for a specific task will be developed utilizing the job safety analyses presented in Section 3.4. The following areas will be addressed:

- Identify activity being performed; Sequence of work
- Hazards to be controlled in each activity
- Hazard control measures

The analysis will be discussed with all site personnel performing the task and will be documented in a site log. Prior to work on site, all site personnel will undergo a safety and health orientation including discussion of the HASP and site conditions. Prior to each shift, a daily safety meeting will be held discussing the previous day's and the current days's health and safety issues.

### 3.5.3 Subcontractors

All subcontractor employees are subject to the same training and medical surveillance requirements as OHM personnel depending on job activity. All subcontractor personnel will be required to sign in daily and be required to attend a daily meeting discussing operations and safety issues. All subcontractors involved in construction/remedial activities will be required to submit a Subcontractor Safety Prequalification Questionnaire prior to the award of a contract. Subcontractors will submit Job Safety analyses for their work activities to the OHM SS. The subcontractor reports directly to the OHM Project Manager. All incidents involving subcontractor employees shall be reported to the OHM Site Supervisor and a copy of the subcontractor's injury/illness report shall be submitted to the OHM SS within 24 hours.

### 3.5.4 Local Requirements

OHM will comply with any applicable local requirements such as noise control and traffic rules at the site. Traffic control will be developed as is needed for specific tasks.

### 3.5.5 Housekeeping

The project site will be kept in a neat and orderly fashion to prevent common injuries due to slips, trips, and falls, accumulation of trash to keep insects away, and to maintain a professional work site. Personnel shall not leave a work area in a disorderly condition. The SS responsible for housekeeping.

### 3.5.6 Emergency and Contingency Plan

OHM has developed an emergency contingency plan provided in section 8.0 of this HASP.

### 3.5.7 Safety Inspections

The Site Supervisor will perform regular safety inspections. A report, including results of the inspection and any corrective actions taken, will be kept in the project files. A copy will be provided to the client representative. Identified safety deficiencies and corrective measures will also be recorded in the "Contractors QC Report."

# 4.0 WORK AND SUPPORT AREAS

To prevent migration of contamination from personnel and equipment work areas will be clearly specified prior to beginning operations. OHM has designated work areas or zones as suggested by the NIOSH/OSHA/USCG/EPA'S document, titled "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities." Each work area will be divided into three zones as follows:

- An Exclusion or "hot" Zone (EZ)
- A Contamination Reduction Zone (CRZ)
- A Support Zone (SZ)

## 4.1 EXCLUSION ZONE

The EZ is the area suspected of contamination and presents the greatest potential for worker exposure. Personnel entering the area must wear the mandated level of protection for that area. In certain instances, different levels of protection will be required depending on the tasks and monitoring performed within that zone. The EZ for this project will be the interior of the Site 7 excavation area and the interior of the haul truck beds.

## 4.2 CONTAMINATION REDUCTION ZONE

The CRZ or transition zone will be established between the EZ and SZ. In this area, personnel will begin the sequential decontamination process required to exit the EZ. To prevent off-site migration of contamination and for personnel accountability, all personnel will enter and exit the EZ through the CRZ. The CRZ for this project will be the access/egress routes to/from the EZ and the personnel and equipment decontamination stations.

## 4.3 SUPPORT ZONE

The SZ serves as a clean, control area. Operational support facilities are located within the SZ. Normal work clothing and support equipment are appropriate in this zone. Contaminated equipment, or clothing will not be allowed in the SZ. The support facilities should be located upwind of site activities. There will be a clearly marked controlled access point from the SZ into the CRZ and EZ that is monitored closely by the SSO and the SS to ensure proper safety protocols are followed. The SZ will be the crew and office trailer, site parking areas and vendor access roads.

## 4.4 SITE CONTROL LOG

A log of all personnel visiting, entering or working on the site shall be maintained in the main office trailer location. The log will record the date, name, company or agency, and time entering or exiting the site.

No visitor will be allowed in the EZ without showing proof of training and medical certification, per 29 CFR 1910.120(e), (f). Visitors will supply their own boots and respiratory equipment, if required. Visitors will attend a site orientation given by the SSO and sign the HASP.

## 4.5 GENERAL

The following items are requirements to protect the health and safety of workers and will be discussed in the safety briefing prior to initiating work on the site:

- Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand to mouth transfer and ingestion of contamination is prohibited in the EZ and CRZs.
- Hands and face must be washed upon leaving the EZ and before eating, drinking, chewing gum or tobacco and smoking or other activities which may result in ingestion of contamination.
- A buddy system will be used. Hand signals will be established to maintain communication.
- During site operations, each worker will consider himself as a safety backup to his partner. Off-site personnel provide emergency assistance. All personnel will be aware of dangerous situations that may develop.
- Visual contact will be maintained between buddies on site when performing hazardous duties.
- No personnel will be admitted to the site without the proper safety equipment, training, and medical surveillance certification.
- All personnel must comply with established safety procedures. Any staff member who does not comply with safety policy, as established by the SSO or the SS, will be immediately dismissed from the site.
- Proper decontamination procedures must be followed before leaving the site.
- All employees and visitors must sign in and out of the site.

# 5.0 PROTECTIVE EQUIPMENT

This section addresses the various levels of personal protective equipment (PPE) which are or may be required at this job site. OHM personnel are trained in the use of all PPE utilized.

## 5.1 ANTICIPATED PROTECTION LEVELS

| TASK | PROTECTION LEVEL | COMMENTS/MODIFICATIONS |
|---|---|---|
| Site Setup, Clear, Grub, Tree felling, Install Erosion Controls, Site Restoration | Level D | Hardhat, steel-toe work boots, safety eye wear (safety glasses with side shields or goggles and face shield if splash or flying particles are likely) and hearing protection >85 dBA |
| Biocell, Decontamination Pad Construction, Truck loading, Hauling | Level D | Hardhat, steel-toe work boots, safety eye wear (safety glasses with side shields or goggles and face shield if splash or flying particles are likely) and hearing protection >85 dBA |
| Soil Excavation | Level D+/C | Tyvek coveralls, nitrile gloves, neoprene boots; upgrade to Level C if "action levels" are exceeded (0.25 $mg/m^3$) |
| CRZ Workers, Equipment Decontamination | Level D+ | Splash suit, nitrile gloves, neoprene or latex boots |
| SZ Workers | Level D | |

## 5.2 PROTECTION LEVEL DESCRIPTIONS

This sections lists the minimum requirements for each protection level. Modification to these requirements will be noted above.

### 5.2.1 Level D

Level D consists of the following:

- Safety glasses with side shields
- Hard hat
- Steel-toed work boots
- Work clothing as prescribed by weather

### 5.2.2 Modified Level D

Modified Level D consists of the following:

- Safety glasses with side shields
- Hard hat
- Steel-toed work boots
- Nitrile, neoprene, latex or PVC overboots

- Outer nitrile, neoprene, or PVC gloves over latex sample gloves
- Face shield (when projectiles or splashes pose a hazard)
- Tyvek coverall [Polyethylene-coated Tyveks required when workers have a potential to be exposed to contaminated liquids or sludges.]

### 5.2.3 Level C

Level C consists of the following:

- Full-face, air-purifying respirator with appropriate cartridges
- Hooded Tyvek Coveralls [Polyethylene-coated Tyveks required when workers have a potential to be exposed to contaminated liquids or sludges].
- Hard hat
- Steel-toed work boots
- Nitrile, neoprene, latex or PVC overboots
- Nitrile, neoprene, or PVC gloves over latex sample gloves
- Face shield (when projectiles or splashes pose a hazard)

### 5.2.4 Level B

Level B protection consists of the items required for Level C protection with the exception that an air-supplied respirator is used in place of the air-purifying respirator.

## 5.3 SUPPLIED-AIR RESPIRATORS

If air monitoring shows that Level B protection is needed, OHM personnel will wear Survivair 9881-02 Hippack Airline respirators with 5-minute egress bottles. Personnel requiring Level "B" protection and high mobility will wear Survivair Mark 2 SCBA units.

## 5.4 BREATHING-AIR QUALITY

Code of Federal Regulations 29 CFR 1910.134 states breathing air will meet the requirement of the specification for Grade D breathing air as described in the ANSI/CGA Specification G-7.1-1989. OHM requires a certificate of analysis from vendors of breathing air in order to show that the air meets this standard. Breathing air will be obtained in cylinders exclusively and will be stationed in the exclusion zone (EZ).

## 5.5 AIR-PURIFYING RESPIRATORS

A NIOSH approved full face respirator with appropriate air purifying cartridges will be used for level C work.

## 5.6 RESPIRATOR CARTRIDGES

The crew members working in Level C will wear respirators equipped with air-purifying cartridges approved for the following contaminants.

- Organic vapors <1,000 ppm
- Chlorine gas <10 ppm
- Hydrogen chloride <50 ppm
- Sulfur dioxide <50 ppm

- Dusts, fumes and mists with a TWA <0.05 mg/m$^3$
- Asbestos-containing dusts and mists
- Radionuclides

## 5.7 CARTRIDGE CHANGES

All cartridges will be changed a minimum of once daily, or more frequently if personnel begin to experience increased inhalation resistance or breakthrough of a chemical warning property.

## 5.8 INSPECTION AND CLEANING

Respirators are checked periodically by a qualified individual and inspected before each use by the wearer. All respirators and associated equipment will be decontaminated and hygienically cleaned after each use.

## 5.9 FIT TESTING

Annual respirator fit tests are required of all personnel wearing negative-pressure respirators. The test will use isoamyl acetate or irritant smoke. The fit test must be for the style and size of the respirator to be used.

## 5.10 FACIAL HAIR

No personnel who have facial hair which interferes with the respirator's sealing surface will be permitted to wear a respirator and will not be permitted to work in areas requiring respirator use.

## 5.11 CORRECTIVE LENSES

Normal eyeglasses cannot be worn under full-face respirators because the temple bars interfere with the respirator's sealing surfaces. For workers requiring corrective lenses, special spectacles designed for use with respirators will be provided.

## 5.12 CONTACT LENSES

Contact lenses will not be worn with any type of respirator.

## 5.13 MEDICAL CERTIFICATION

Only workers who have been certified by a physician as being physically capable of respirator usage will be issued a respirator. Personnel unable to pass a respiratory fit test or without medical clearance for respirator use will not be permitted to enter or work in areas on site that require respiratory protection. Employees receive a written physicians opinion that they are fit for general hazardous waste operations as per 29 CFR 1910.120(f)(7).

## 5.14 SITE SPECIFIC PERSONAL PROTECTIVE EQUIPMENT (PPE) PROGRAM

The primary objective of the PPE program is to ensure employee protection and to prevent employee exposure to site contaminants during site operations. Engineering controls are not feasible for many tasks and, therefore, require the use of PPE.

The SS will be responsible for implementing all aspects of the PPE program. This includes donning and doffing, temperature related stress monitoring, inspection, and decontamination (see Section 6.0). PPE selection is identified in Table 5.1 for each specified task. The SS in consultation with the SSO, if assigned, Health and Safety Manager, project CIH and the ROICC will direct changes in PPE based on changing conditions. The site specific HASP will serve as written certification that the workplace was evaluated concerning PPE requirements. OHM Corporation's comprehensive PPE Program is described in Appendix D.

### 5.14.1 Site-Specific Respiratory Protection Program

The primary objective of respiratory protection is to prevent employee exposure to atmospheric contamination. When engineering measures to control contamination are not feasible, or while they are being implemented, personal respiratory protective devices will be used.

The criteria for determining respirator need have been evaluated based on the site contaminants; expected levels of protection are outlined in Section 5.1. Air monitoring will be conducted to confirm that respiratory protection levels are adequate (Section 7.0). All respirator users are OSHA trained in proper respirator use and maintenance. The SS and SSO will observe workers during respirator use for signs of stress. The SS, CIH, HSM, and SSO will also evaluate this HASP periodically to determine its continued effectiveness with regard to respiratory protection. All persons assigned to use respirators will have medical clearance to do so.

# 6.0 DECONTAMINATION PROCEDURES

This section describes the procedures necessary to ensure that both personnel and equipment are free from contamination when they leave the work site.

## 6.1 PERSONNEL DECONTAMINATION

Decontamination procedures will ensure that material which workers may have contacted in the EZ does not result in personal exposure and is not spread to clean areas of the site. This sequence describes the general decontamination procedure. The specific stages will vary depending on the site, the task, the protection level, etc.

*Level C Decontamination*

1. Go to end of EZ
2. a. Wash outer boots (Tingley or Robars) and stage to let dry; or
   b. Remove and discard latex booties
3. Remove outer gloves and discard
4. Remove outer suit (Saranex/polycoated/regular tyvek)
5. Remove outer sample gloves and discard
6. Cross into CRZ (dirty side of respirator wash area)
7. Remove inner suit and discard, (if applicable)
8. Remove and wash respirator (4 stages)
   a. Soap and water solution
   b. First rinse
   c. Disinfect respirator (1 cap full of bleach to 1 gallon of water)
   d. Final rinse
9. Hang respirator to dry
10. Remove inner sample gloves and discard
11. Wash face and hands

*Level B Decontamination (SCBA)*

1. Move to edge of EZ
2. Bottle change only
   a. Wash boots and gloves
   b. Move to edge of EZ and CRZ
   c. Remove face mask airline from regulator assembly
   d. Allow assistant to change bottle and reconnect face mask airline
   e. Return to EZ
3. a. Wash outer boots and stage to let dry (Tingley or Robars only); or
   b. Remove and discard latex booties
4. Remove and discard outer gloves
5. Disconnect from SCBA bottle and stage SCBA (NOTE: SCBA mask remains on)
6. Remove outer suit (Saranex/polycoated/regular tyvek)
7. Remove outer sample gloves and discard
8. Cross into CRZ
9. Remove inner suit (if applicable)

10. Move to respirator wash area and wash SCBA facepiece and hose line
    a. Soap and water solution
    b. First rinse
    c. Disinfect respirator (1 cap full of bleach to 1 gallon of water)
    d. Final rinse
11. Hang mask to dry
12. Remove inner sample gloves and discard
13. Wash face and hands

### 6.1.1 Suspected Contamination

Any employee suspected of sustaining skin contact with chemical materials will first use the emergency shower. Following a thorough drenching, the worker will proceed to the decontamination facility. Here the worker will remove clothing, shower, don clean clothing, and immediately be taken to the first-aid station. Medical attention will be provided at determined by the degree of injury.

### 6.1.2 Personal Hygiene

Before any eating, smoking, or drinking, personnel will wash hands, arms, neck and face.

## 6.2 EQUIPMENT DECONTAMINATION

All contaminated equipment will be decontaminated before leaving the site. Decontamination procedures will vary depending upon the contaminant involved, but may include sweeping, wiping, scraping, hosing, or steaming the exterior of the equipment. Personnel performing this task will wear the proper PPE as prescribed by the SSO.

## 6.3 DISPOSAL

All decontamination liquids and disposable clothing will be treated as contaminated waste unless determined otherwise by accepted testing methods. Wastes will be disposed of according to state and federal regulations.

# 7.0 AIR MONITORING

Air monitoring will be conducted in order to determine airborne contamination levels. This ensures that respiratory protection is adequate to protect personnel against the chemicals that are encountered. The following air monitoring efforts will be used at this site. Additional air monitoring may be conducted at the discretion of the SSO.

The following chart describes the air monitoring required and appropriate action levels.

| Monitoring Device | Action Level | Action |
|---|---|---|
| LEL/$O_2$ | >10% LEL<br><20.8% $O_2$ | Evacuate area, ventilate, upgrade to Level B if necessary, continue to monitor |
| PID | 1-5 ppm unknowns<br>5-500 ppm unknowns<br>>500 ppm unknowns | Level C<br>Level B<br>Level A |
| Mini-Ram (total dust) | <0.25 $mg/m^3$<br>≥0.25 $mg/m^3$ - ≤2.5 $mg/m^3$<br>>2.5 $mg/m^3$ | Level D<br>Level C<br>Level B |

## 7.1 LOWER EXPLOSIVE LIMIT/OXYGEN (LEL/$O_2$) METER

Prior to entering a confined-space area or hot work involving welding, cutting, or other high heat-producing operations where flammable or combustible vapors may be present, LEL/$O_2$ measurements will be taken.

### 7.1.1 Type and Operational Aspects

- MSA Combustible Gas/Oxygen Meter Model 260
  - Principle of Operation
    - Oxygen detector uses an electrochemical sensor; produces a minute electric current proportional to the oxygen content.
    - Combustible gas indicators use a combustion chamber containing a filament that ignites flammable vapors; filament is heated or coated with a catalyst (platinum) to facilitate combustion.
    - Filament is part of a balanced resistor circuit; combustion in the chamber causes the filament temperature to increase; results in increased filament resistance.
    - Change in the filament's resistance causes an imbalance in the circuit proportional to the percent of the lower explosive limit (% LEL).
    - Concentrations greater than the LEL and lower than the upper explosive limit (UEL) will read 100% LEL; combustible atmosphere present.

- Concentrations greater than the UEL will read above 100% LEL then return to zero. (NOTE: Some devices have catchment mechanisms which will cause the needle to remain at 100% until the meter is reset.) This type of response indicates the gas mixture is too rich to burn and is not combustible. The danger is that the addition of air to the gas mixture could bring it into the flammable range (less than the UEL).

- Oxygen meter set at the factory to alarm at 19.5% (oxygen deficient atmosphere) combustible gas meter set by the user to alarm at 10% LEL.

### 7.1.2 Calibration Methods/Frequencies

Before the calibration of the combustible gas indicator can be checked, the Model 260 must be in operating condition. The Model 260 combustible gas indicator is normally calibrated on pentane as being representative of the flammability characteristics of most commonly encountered combustible gases. The meter scale is calibrated from zero to 100% LEL, which corresponds in actual volume concentrations of 0 to approximately 14% pentane in air. A booklet of response curves is supplied with the Model 260. These curves may be used to interpret meter readings when sampling combustible gases other than pentane.

It is recommended that calibration be checked before and after using each time. The SSO will record and log such calibration information into an air monitoring notebook. The $O_2$ meter is calibrated by adjusting the $O_2$ control knob to 20.8% while the meter is operated in a fresh air atmosphere.

### 7.1.3 Preventative Maintenance

The primary maintenance of the Model 260 is the rechargeable 2.4 volt nickel cadmium battery. Recommended charging time is 16 hours. It may be left on charge for longer periods without damaging the battery. The battery sometimes will not supply full power capacity after repeated partial use between charging. Therefore, it is recommended that the battery be exercised at least once a month by running for eight to 10 hours and recharged. If the instrument has not been used for 30 days, the battery should be charged prior to use.

## 7.2 PHOTOIONIZATION DETECTOR (PID)

A PID will be used to monitor total ionizable organic content of the ambient air. A PID will prove useful as a direct reading instrument to aid in determining if respiratory protection needs to be upgraded and to define the EZ. (Note: PID readings do not always indicate the actual air concentration of a compound. Consult the manual, HNU, or the CIH for clarification.)

The SSO will take measurements before operations begin in an area to determine the amount of organic compounds naturally occurring in the air. This is referred to as a background level.

Levels of volatile organic compounds will be measured in the air at active work sites once every hour and at the support zone once every hour when levels are detected above background in the exclusion zone. If levels exceed background at any time in the support zone, work in the exclusion zone will cease and corrective actions will be taken, e.g., cover soil with polyethylene sheeting. Work will not resume until levels reach background in the support zone.

### 7.2.1 Type and Operational Aspects

- PID Model PI 101
  - Principle of Operation
    - Ionization potential (IP) - The energy required to remove the outermost electron from a molecule; measured in electron volts (eV); characteristic property of a specific chemical.
    - Photoionization - Using ultraviolet (UV) light to remove the outermost electron from a molecule.
    - Energy of UV light (10.2, 9.5, 11.7 eV) must be equal to or greater than the IP to photoionize the molecule.
    - Fan or pump is used to draw air into the detector where the contaminants are exposed to a UV light source (lamp).
    - Ions are collected on a charged plate and produce a current directly proportional to the number of ionized molecules; current is amplified and displayed on the meter.

### 7.2.2 Calibration Method/Frequencies

The PID Model PI 101 is designed for trace gas analysis in ambient air and is calibrated at HNU with certified standards of benzene, vinyl chloride, and isobutylene. Other optional calibrations are available (e.g., ammonia, ethylene oxide, $H_2S$, etc.).

OHM will use a PID with a 10.2 eV lamp. This lamp has been determined to be most responsive to the contaminants on site. Optional probes containing lamps of 9.5 and 11.7 eV are interchangeable in use within individual read-out assemblies for different applications.

The approximate span settings for the probe that would give different readings of the amounts of trace gas of a particular species in a sample are based upon the relative photoionization sensitivities of various gases twice daily (beginning and end of shift).

It is recommended that calibration be checked twice each day (beginning and end of shift). The SSO will record and log such calibration information into an air monitoring notebook.

### 7.2.3 Preventative Maintenance

Maintenance of the PID Model PI 101 consists of cleaning the lamp and ion chamber, and replacement of the lamp or other component parts or sub-assemblies.

## 7.3 PORTABLE TOTAL DUST MONITOR

A mini-ram will be used to monitor the general respirable dust levels on this site. The air sampling will be performed at designated locations at the site perimeter, upwind and downwind of the active work areas in the (EZ). Site conditions will determine the frequency and duration of dust monitoring. Mini-ram readings will trigger dust abatement actions and PPE upgrades.

### 7.3.1 Type and Operational Aspects

- Real-Time Aerosol Monitor (Mini Ram Model PDM-3)
  - Principle of Operation
    - Detection of light in the near infrared region back-scattered to a sensor (photovoltaic detector) by airborne particulate in a sensing volume
    - The higher the dust concentration the more back-scattering of light to the sensor, resulting in increased readings
    - Device calibrated at the factory against an air sampling filter/gravimetric analysis reference method

### 7.3.2 Calibration Methods/Frequencies

There is no calibration method or procedure for calibrating the mini-ram monitor. However, it is recommended that the mini-ram monitor be re-zeroed once a week. During a zero check, the sampled air passes through the purge air filter and dryer to effect a self-cleaning of the optical chamber.

### 7.3.3 Preventative Maintenance

Maintenance of the mini-ran consists of replacement of filters and desiccant; battery replacement; and cleaning of the optical detection assembly.

## 7.4 AIR MONITORING LOG

The SSO will ensure that all air-monitoring data is logged into a monitoring notebook. Data will include instrument used, wind direction, work process, etc. The Regional and Corporate OHM CIH will periodically review this data.

## 7.5 CALIBRATION REQUIREMENTS

The PID, LEL/$O_2$ meter and sampling pumps required with fixed-media air sampling will be calibrated daily before and after use. A separate log will be kept detailing date, time, span gas, or other standard, and name of person performing the calibration.

## 7.6 AIR MONITORING RESULTS

Air monitoring results will be posted for personnel inspection, and will be discussed during morning safety meetings.

# 8.0 EMERGENCY RESPONSE

## 8.1 PRE-EMERGENCY PLANNING

Prior to engaging in construction/remediation activities at the site, OHM will plan for possible emergency situations and have available adequate supplies and manpower to respond. In addition site personnel will receive training during the site orientation concerning proper emergency response procedures.

The following situations would warrant implementation of the Emergency Response and Contingency Plan (ERCP):

| | |
|---|---|
| Fire/Explosion | • The potential for human injury exists.<br>• Toxic fumes or vapors are released.<br>• The fire could spread on site or off site and possibly ignite other flammable materials or cause heat-induced explosions.<br>• The use of water and/or chemical fire suppressants could result in contaminated run-off.<br>• An imminent danger of explosion exists. |
| Spill or Release of Hazardous Materials | • The spill could result in the release of flammable liquids or vapors, thus causing a fire or gas explosion hazard.<br>• The spill could cause the release of toxic liquids or fumes in sufficient quantities or in a manner that is hazardous to or could endanger human health. |
| Natural Disaster | • A rain storm exceeds the flash flood level.<br>• The facility is in a projected tornado path or a tornado has damaged facility property.<br>• Severe wind gusts are forecasted or have occurred and have caused damage to the facility. |
| Medical Emergency | • Overexposure to hazardous materials.<br>• Trauma injuries (broken bones, severe lacerations/bleeding, burns).<br>• Eye/skin contact with hazardous materials.<br>• Loss of consciousness.<br>• Heat stress (Heat stroke).<br>• Cold stress (Hypothermia).<br>• Heart attack.<br>• Respiratory failure.<br>• Allergic reaction. |

The following measures will be taken to assure the availability of adequate equipment and manpower resources:

- Sufficient equipment and materials will be kept on site and dedicated for emergencies only. The inventory will be replenished after each use.

- On-site emergency responders will be current in regards to training and medical surveillance programs. Copies of all applicable certificates will be kept on file for on-site personnel required to respond.

- It will be the responsibility of the emergency coordinator to brief the on-site response team on anticipated hazards at the site. The emergency coordinator shall also be responsible for anticipating and requesting equipment that will be needed for response activities.

- Emergency response activities will be coordinated with the Local Emergency Management Agency ( EMA) in compliance with SARA Title III requirements.

Communications will be established prior to commencement of any activities at the remediation site. Communication will be established so that all responders on site have availability to all pertinent information to allow them to conduct their activities in a safe and healthful manner. The primary communication device will be two-way radios. Air horns may be used to alert personnel of emergency conditions. A telephone will be located at the command post to summon assistance in an emergency.

Primary communication with local responders in the event of an emergency will be accomplished using commercial telephone lines.

## 8.2 EMERGENCY RECOGNITION AND PREVENTION

Because unrecognized hazards may result in emergency incidents, it will be the responsibility of the Site Supervisor and Site Safety Officer (SSO), through daily site inspections and employee feedback (Safety Observation Program, daily safety meetings, and job safety analyses) to recognize and identify all hazards that are found at the site. These may include:

| | |
|---|---|
| Chemical Hazards | • Materials at the site<br>• Materials brought to the site |
| Physical Hazards | • Fire/explosion<br>• Slip/trip/fall<br>• Electrocution<br>• Confined space<br>• IDLH atmospheres<br>• Excessive noise |
| Mechanical Hazards | • Heavy equipment<br>• Stored energy system<br>• Pinch points<br>• Electrical equipment<br>• Vehicle traffic |
| Environmental Hazards | • Electrical Storms<br>• High winds<br>• Heavy Rain/Snow<br>• Temperature Extremes (Heat/Cold Stress)<br>• Poisonous Plants/Animals |

Once a hazard has been recognized, the Site Supervisor and/or the SSO will take immediate action to prevent the hazard from becoming an emergency. This may be accomplished by the following:

- Daily safety meeting
- Task-specific training prior to commencement of activity
- Lock-out/tag-out
- Personal Protective Equipment (PPE) selection/use

- Written and approved permits for hot work, confined space
- Trenching/shoring procedure
- Air monitoring
- Following all OHM standard operating procedures
- Practice drills for fire, medical emergency, and hazardous substances spills

**TABLE 8.1**
**EMERGENCY TELEPHONE NUMBERS**

| | |
|---|---|
| Local Agencies All services | |
| WPNSTA Yorktown Fire, Police, and Ambulance | 804-887-4911 |
| WPNSTA Yorktown Security | 804-887-7103 |
| Hospital -Riverside Regional Medical Ctr., 500 J Clyde Morris Blvd., Newport News, VA<br>*Directions:* From Yorktown follow US Rt 17 S; follow US Rt 17 to junction with VA Rt 312; follow Rt 312 (J Clyde Morris Blvd) Hospital is on Left between Jefferson Ave., and Warwick Blvd. | 804-594-2000<br>804-594-2050 E/R |
| Regional Poison Control Center | 800-552-6337 |
| State Agencies | |
| Virginia Department of Environmental Quality | 804-772-4000 |
| Federal Agencies | |
| EPA Region Branch Response Center | 215-597-9800 |
| Agency for Toxic Substances and Disease Registry | 404-639-0615 (24 HR) |
| Navy ROICC / NTR | |
| Lt Leanne Currie | 804-887-4161 |
| Rich Stryker | 757-322-4778 |
| U.S. Coast Guard | 804-484-8192 |
| National Response Center | 800-424-8802 |
| OHM Personnel | |
| Project Manager - Mark Kravecz | 609-588-6484 |
| District Health & Safety Manger - Bob Brooks | 609-588-6423 |
| Director, Health and Safety - Kevin McMahon | 609-588-6375 |
| OHM Corporation (24 hour) | 800-537-9540 |

Additional Phone #'s in Section 2 this HASP

## 8.3 PERSONNEL ROLES, LINES OF AUTHORITY, AND COMMUNICATIONS

This section of the ERCP describes the various roles, responsibilities, and communication procedures that will be followed by personnel involved in emergency responses.

The primary emergency coordinator for this site is the Site Supervisor. In the event an emergency occurs and the emergency coordinator is not on site, the Site Safety Officer or the highest ranking employee on site will serve as the emergency coordinator until he arrives. The emergency coordinator will determine the nature of the emergency and take appropriate action as defined by this ERCP.

The emergency coordinator will implement the ERCP immediately as required. The decision to implement the plan will depend upon whether the actual incident threatens human health or the environment. Immediately after being notified of an emergency incident, the emergency coordinator or his designee will evaluate the situation to determine the appropriate action.

### 8.3.1 Responsibilities and Duties

This section describes the responsibilities and duties assigned to the emergency coordinator.

It is recognized that the structure of the "Incident Command System" will change as additional response organizations are added. OHM will follow procedures as directed by the fire department, LEPC, State and Federal Agencies as required. OHM will defer to the local Fire Department chief to assume the role of Incident Commander upon arriving on site. Additional on-site personnel may be added to the Site Emergency Response Team as required to respond effectively.

### 8.3.2 On-Site Emergency Coordinator Duties

The on-site emergency coordinator is responsible for implementing and directing the emergency procedures. All emergency personnel and their communications will be coordinated through the emergency coordinator. Specific duties are as follows:

- Identify the source and character of the incident, type and quantity of any release. Assess possible hazards to human health or the environment that may result directly from the problem or its control.
- Discontinue operations in the vicinity of the incident if necessary to ensure that fires, explosions, or spills do not recur or spread to other parts of the site. While operations are dormant, monitor for leaks, pressure build-up, gas generation, or ruptures in valves, pipes, or other equipment, where appropriate.
- Notify local Emergency Response Teams if their help is necessary to control the incident. Table 8.1 provides telephone numbers for emergency assistance.
- Direct on-site personnel to control the incident until, if necessary, outside help arrives.
- Ensure that the building or area where the incident occurred and the surrounding area are evacuated and shut off possible ignition sources, if appropriate. The Emergency Response Team is responsible for directing site personnel such that they avoid the area of the incident and leave emergency control procedures unobstructed.
- If fire or explosion is involved, notify facility Fire Department.
- Notify NAVY ROICC
- Notify OHM Project Manager
- Have protected personnel, in appropriate PPE, on standby for rescue.

If the incident may threaten human health or the environment outside of the site, the emergency coordinator should immediately determine whether evacuation of area outside of the site may be necessary and, if so, notify the Police Department and the Office of Emergency Management.

When required, notify the National Response Center. The following information should be provided to the National Response Center:

- Name and telephone number
- Name and address of facility
- Time and type of incident
- Name and quantity of materials involved, if known
- Extent of injuries
- Possible hazards to human health or the environment outside of the facility.

The emergency telephone number for the National Response Center is 800-424-8802.

If hazardous waste has been released or produced through control of the incident, ensure that:

- Waste is collected and contained.
- Containers of waste are removed or isolated from the immediate site of the emergency.
- Treatment or storage of the recovered waste, contaminated soil or surface water, or any other material that results from the incident or its control is provided.
- Ensure that no waste that is incompatible with released material is treated or stored in the facility until cleanup procedures are completed.
- Ensure that all emergency equipment used is decontaminated, recharged, and fit for its intended use before operations are resumed.
- Notify the USEPA Regional Administrator that cleanup procedures have been completed and that all emergency equipment is fit for its intended use before resuming operations in the affected area of the facility. The USEPA Regional Administrator's telephone number is included in the Emergency Contacts.
- Record time, date, and details of the incident, and submit a written report to the USEPA Regional Administrator. Report is due to USEPA within 15 days of the incident.

## 8.4 SAFE DISTANCES AND PLACES OF REFUGE

The emergency coordinator for all activities will be the SS. No single recommendation can be made for evacuation or safe distances because of the wide variety of emergencies which could occur. Safe distances can only be determined at the time of an emergency based on a combination of site and incident-specific criteria. However, the following measures are established to serve as general guidelines.

In the event of minor hazardous materials releases (small spills of low toxicity), workers in the affected area will report initially to the contamination reduction zone. Small spills or leaks (generally less than 55 gallons) will require initial evacuation of at least 50 feet in all directions to allow for cleanup and to prevent exposure. After initial assessment of the extent of the release and potential hazards, the

emergency coordinator or his designee will determine the specific boundaries for evacuation. Appropriate steps such as caution tape, rope, traffic cones, barricades, or personal monitors will be used to secure the boundaries.

In the event of a major hazardous material release (large spills of high toxicity/greater than 55 gallons), workers will be evacuated from the building/site. Workers will assemble at the entrance to the site for a head count by their foremen and to await further instruction.

If an incident may threaten the health or safety of the surrounding community, the public will be informed and, if necessary, evacuated from the area. The emergency coordinator, or his designee will inform the proper agencies in the event that this is necessary. Telephone numbers are listed in Table 8.1.

Places of refuge will be established prior to the commencement of activities. These areas must be identified for the following incidents:

- Chemical release
- Fire/explosion
- Power loss
- Medical emergency
- Hazardous weather

In general, evacuation will be made to the crew trailers, unless the emergency coordinator determines otherwise. It is the responsibility of the emergency coordinator to determine when it is necessary to evacuate personnel to off-site locations.

In the event of an emergency evacuation, all the employees will gather at the entrance to the site until a head count establishes that all are present and accounted for. No one is to leave the site without notifying the emergency coordinator.

## 8.5 EVACUATION ROUTES AND PROCEDURES

All emergencies require prompt and deliberate action. In the event of an emergency, it will be necessary to follow an established set of procedures. Such established procedures will be followed as closely as possible. However, in specific emergency situations, the emergency coordinator may deviate from the procedures to provide a more effective plan for bringing the situation under control. The emergency coordinator is responsible for determining which situations require site evacuation.

### 8.5.1 Evacuation Signals and Routes

Two-way radio communication and an air horn will be used to notify employees of the necessity to evacuate an area or building involved in a release/spill of a hazardous material. Each crew supervisor will have a two way radio. A base station will be installed in the OHM office trailer to monitor for emergencies. Total site evacuation will be initiated only by the emergency coordinator, however, in his absence, decision to preserve the health and safety of employees will take precedence. Evacuation routes will be posted in each outside work area. Signs inside buildings will be posted on walls or other structural element of a building. Periodic drills will be conducted to familiarize each employee with the proper routes and procedures.

### 8.5.2 Evacuation Procedures

In the event evacuation is necessary, the following actions will be taken:

- The emergency signal will be activated.
- No further entry of visitors, contractors, or trucks will be permitted. Vehicle traffic within the site will cease in order to allow safe exit of personnel and movement of emergency equipment.
- Shut off all machinery if safe to do so.
- ALL on-site personnel, visitors, and contractors in the support zone will assemble at the entrance to the site for a head count and await further instruction from the emergency coordinator.
- ALL persons in the exclusion zone and contamination reduction zone will be accounted for by their immediate crew leaders (e.g., foreman). Leaders will determine the safest exits for employees and will also choose an alternate exit if the first choice is inaccessible.
- During exit, the crew leader should try to keep the group together. Immediately upon exit, the crew leader will account for all employees in his crew.
- Upon completion of the head count, the crew leader will provide the information to the emergency coordinator.
- Contract personnel and visitors will also be accounted for.
- The names of emergency response team members involved will be reported to the emergency spill control coordinator.
- A final tally of persons will be made by the emergency coordinator or designee. No attempt to find persons not accounted for will involve endangering lives of OHM or other employees by re-entry into emergency areas.
- In all questions of accountability, immediate crew leaders will be held responsible for those persons reporting to them. Visitors will be the responsibility of those employees they are seeing. Contractors and truck drivers are the responsibility of the Site Supervisor. The security guard will aid in accounting for visitors, contractors, and truckers by reference to sign-in sheets available from the guard shack.
- Personnel will be assigned by the emergency coordinator to be available at the main gate to direct and brief emergency responders.
- Re-entry into the site will be made only after clearance is given by the emergency coordinator. At his direction, a signal or other notification will be given for re-entry into the facility.
- Drills will be held periodically to practice all of these procedures and will be treated with the same seriousness as an actual emergency.

## 8.6 EMERGENCY SPILL RESPONSE PROCEDURES AND EQUIPMENT

In the event of an emergency involving a hazardous material spill or release, the following general procedures will be used for rapid and safe response and control of the situation. Emergency contacts found in Table 8.1 provide a quick reference guide to follow in the event of a major spill.

### 8.6.1 Notification Procedures

If an employee discovers a chemical spill or process upset resulting in a vapor or material release, he or she will immediately notify the on-site emergency coordinator.

On-site Emergency Coordinator will obtain information pertaining to the following:

- The material spilled or released.
- Location of the release or spillage of hazardous material.
- An estimate of quantity released and the rate at which it is being released.
- The direction in which the spill, vapor or smoke release is heading.
- Any injuries involved.
- Fire and/or explosion or possibility of these events.
- The area and materials involved and the intensity of the fire or explosion.

This information will help the on-site emergency coordinator to assess the magnitude and potential seriousness of the spill or release.

### 8.6.2 Procedure for Containing/Collecting Spills

The initial response to any spill or discharge will be to protect human health and safety, and then the environment. Identification, containment, treatment, and disposal assessment will be the secondary response.

If for some reason a chemical spill is not contained within a dike or sump area, an area of isolation will be established around the spill. The size of the area will generally depend on the size of the spill and the materials involved. If the spill is large (greater than 55 gallons) and involves a tank or a pipeline rupture, an initial isolation of at least 100 ft. in all directions will be used. Small spills (less than or equal to 55 gallons) or leaks from a tank or pipe will require evacuation of at least 50 ft. in all directions to allow cleanup and repair and to prevent exposure. When any spill occurs, only those persons involved in overseeing or performing emergency operations will be allowed within the designated hazard area. If possible the area will be roped or otherwise blocked off.

If the spill results in the formation of a toxic vapor cloud (by reaction with surrounding materials or by outbreak of fire) and its release (due to high vapor pressures under ambient conditions), further evacuation will be enforced. In general an area at least 500 feet wide and 1,000 feet long will be evacuated downwind if volatile materials are spilled. (Consult the DOT Emergency Response Guide for isolation distances for listed hazardous materials.)

If an incident may threaten the health or safety of the surrounding community, the public will be informed and possibly evacuated from the area. The on-site emergency coordinator will inform the proper agencies in the event this is necessary. (Refer to Table 8.1)

As called for in regulations developed under the Comprehensive Environmental Response Compensation Liability Act of 1980 (Superfund), OHM's practice is to report a spill of a pound or more of any hazardous material for which a reportable quantity has not been established and which is listed under the Solid Waste Disposal Act, Clean Air Act, Clean Water Act, or TSCA. OHM also follows the same practice for any substances not listed in the Acts noted above but which can be classified as a hazardous waste under RCRA.

Clean up personnel will take the following measures:

- Make sure all unnecessary persons are removed from the hazard area.
- Put on protective clothing and equipment.
- If a flammable material is involved, remove all ignition sources, and use spark and explosion proof equipment for recovery of material.
- Remove all surrounding materials that could be especially reactive with materials in the waste. Determine the major components in the waste at the time of the spill.
- If wastes reach a storm sewer, try to dam the outfall by using sand, earth, sandbags, etc. If this is done, pump this material out into a temporary holding tank or drums as soon as possible.
- Place all small quantities of recovered liquid wastes (55 gallons or less) and contaminated soil into drums for incineration or removal to an approved disposal site.
- Spray the spill area with foam, if available, if volatile emissions may occur.
- Apply appropriate spill control media (e.g. clay, sand, lime, etc.) to absorb discharged liquids.
- For large spills, establish diking around leading edge of spill using booms, sand, clay or other appropriate material. If possible, use diaphragm pump to transfer discharged liquid to drums or holding tank.

### 8.6.3 Emergency Response Equipment

The following equipment will be staged in the support zone and throughout the site, as needed, to provide for safety and first aid during emergency responses. (Emergency eyewash equipment meets ANSI Standard;

- ABC-type fire extinguisher
- First-aid kit, industrial size
- Eyewash/safety shower
- Emergency signal horn
- Self contained breathing apparatus (two)
- Stretcher/backboard

In addition to the equipment listed above, OHM maintains direct reading instrumentation that may be used in emergency situations to assess the degree of environmental hazard. This equipment will only be used by the Site Safety Officer or other specially trained personnel. This equipment will be stored,

charged and ready for immediate use in evaluating hazardous chemical concentrations. The equipment will be located at the OHM office trailer.

| EQUIPMENT NAME | APPLICATION |
|---|---|
| Portable H-NU Photoionization Meter | Measures selected inorganic and organic chemical concentrations |
| MSA Oxygen and Combustible Gas Meter | Measures oxygen and combustible gas levels |
| Draeger Detector Tubes | Assorted detector tubes to measure specific chemical concentrations |

### 8.6.4 Personal Protective Equipment

A supply of two (minimum) SCBAs will be located in the support zone for use in emergency response to hazardous materials releases. They will be inspected at least monthly, according to OSHA requirements. In addition, all emergency response personnel will have respirators available for use with cartridge selection determined by the Site Safety Officer based on the results of direct reading instruments. Emergency response personnel will also be provided with protective clothing as warranted by the nature of the hazardous material and as directed by the Site Safety Officer.

### 8.6.5 Emergency Spill Response Clean-Up Materials and Equipment

A sufficient supply of appropriate emergency response clean-up and personal protective equipment will be inventoried and inspected, visually, on a weekly basis.

The materials listed below may be kept on site for spill control, depending on the types of hazardous materials present on site. The majority of this material will be located in the support zone, in a supply trailer or storage area. Small amounts will be placed on pallets and located in the active work areas.

- Sand or clay to solidify/absorb liquid spills.
- Lime (calcium oxide), soda ash (sodium carbonate), or baking soda (sodium bicarbonate) for neutralizing acid (pH $< 7$) spills.
- Activated charcoal (carbon) to adsorb organic solvents (hydrocarbons) and to reduce flammable vapors.
- Citric acid for neutralizing caustic (pH $> 7$) spills.
- Appropriate solvents, e.g., CITRIKLEEN, for decontamination of structures or equipment.

The following equipment will be kept on site and dedicated for spill cleanup:

- Plastic shovels for recovering corrosive and flammable materials.
- Sausage-shaped absorbent booms for diking liquid spills, drains, or sewers.
- Sorbent sheets (diapers) for absorbing liquid spills.
- Overpack drums for containerizing leaking drums.
- 55-gallon open-top drums for containerization of waste materials.

*NOTE: All contaminated soils, absorbent materials, solvents and other materials resulting from the clean-up of spilled or discharged substances shall be properly stored, labeled, and disposed of off-site.

## 8.7 EMERGENCY CONTINGENCY PLAN

This section of the ERCP details the contingency measures OHM will take to prepare for and respond to fires, explosions, spills and releases of hazardous materials, hazardous weather, and medical emergencies.

## 8.8 MEDICAL EMERGENCY CONTINGENCY MEASURES

The procedures listed below will be used to respond to medical emergencies. The SSO will contact the local hospital and inform them of the site hazards and potential emergency situations. A minimum of two First-Aid/CPR trained personnel will be maintained on site.

### 8.8.1 Response

The nearest workers will immediately assist a person who shows signs of medical distress or who is involved in an accident. The work crew supervisor will be summoned.

The work crew supervisor will immediately make radio contact with the on-site emergency coordinator to alert him of a medical emergency situation. The supervisor will advise the following information:

- Location of the victim at the work site
- Nature of the emergency
- Whether the victim is conscious
- Specific conditions contributing to the emergency, if known

The Emergency Coordinator will notify the Site Safety Officer. The following actions will then be taken depending on the severity of the incident:

- Life-Threatening Incident — If an apparent life-threatening condition exists, the crew supervisor will inform the emergency coordinator by radio, and the local Emergency Response Services (EMS) will be immediately called. An on-site person will be appointed who will meet the EMS and have him/her quickly taken to the victim. Any injury within the EZ will be evacuated by OHM personnel to a clean area for treatment by (EMS) personnel. No one will be able to enter the EZ without showing proof of training, medical surveillance and site orientation.

- Non Life-Threatening Incident — If it is determined that no threat to life is present, the Site Safety Officer will direct the injured person through decontamination procedures (see below) appropriate to the nature of the illness or accident. Appropriate first aid or medical attention will then be administered.

*NOTE: The area surrounding an accident site must not be disturbed until the scene has been cleared by the Site Safety Officer.

Any personnel requiring emergency medical attention will be evacuated from exclusion and contamination reduction zones if doing so would not endanger the life of the injured person or otherwise aggravate the injury. Personnel will not enter the area to attempt a rescue if their own lives would be threatened. The decision whether or not to decontaminate a victim prior to evacuation is based on the type and severity of the illness or injury and the nature of the contaminant. For some emergency victims, immediate decontamination may be an essential part of life-saving first aid. For others, decontamination may aggravate the injury or delay life-saving first aid. Decontamination will be performed if it does not interfere with essential treatment.

If decontamination can be performed, observe the following procedures:

- Wash external clothing and cut it away.

If decontamination cannot be performed, observe the following procedures:

- Wrap the victim in blankets or plastic to reduce contamination of other personnel.
- Alert emergency and off-site medical personnel to potential contamination, instruct them about specific decontamination procedures.
- Send site personnel familiar with the incident and chemical safety information, e.g. MSDS, with the affected person.

All injuries, no matter how small, will be reported to the SSO or the Site Supervisor. An accident/injury/illness report will be completely and properly filled out and submitted to the Regional Health and Safety Director/Project CIH, in accordance with OHM's reporting procedures.

A list of emergency telephone numbers is given in Table 8.1.

### 8.8.2 Notification

The following personnel/agencies will be notified in the event of a medical emergency:

- Local Fire Department or EMS
- On-site Emergency Coordinator
- Workers in the affected areas
- Client Representative

## 8.9 FIRE CONTINGENCY MEASURES

OHM personnel and subcontractors are not trained professional firefighters. Therefore, if there is any doubt that a fire can be quickly contained and extinguished, personnel will notify the emergency coordinator by radio and vacate the structure or area. The emergency coordinator will immediately notify the local Fire Department.

The following procedures will be used to prevent the possibility of fires and resulting injuries:

- Sources of ignition will be kept away from where flammable materials are handled or stored.
- The air will be monitored for explosivity before and during hot work and periodically where flammable materials are present. Hot work permits will be required for all such work.
- "No smoking" signs will be conspicuously posted in areas where flammable materials are present.
- Fire extinguishers will be placed in all areas where a fire hazard may exist.
- Before workers begin operations in an area the foreman will give instruction on egress procedures and assembly points. Egress routes will be posted in work areas and exit points clearly marked.

### 8.9.1 Response

The following procedures will be used in the event of a fire:

- Anyone who sees a fire will notify their supervisor who will then contact the Emergency Coordinator by radio. The emergency coordinator will activate the emergency air horns and contact the local Fire Department.
- When the emergency siren sounds, workers will disconnect electrical equipment in use (if possible) and proceed to the nearest fire exit.
- Work crews will be comprised of pairs of workers (buddy system) who join each other immediately after hearing the fire alarm and remain together throughout the emergency. Workers will assemble at a predetermined rally point for a head count.
- When a small fire has been extinguished by a worker, the emergency coordinator will be notified.

## 8.10 HAZARDOUS WEATHER CONTINGENCY MEASURES

Operations will not be started or continued when the following hazardous weather conditions are present:

- Lightning
- Heavy Rains/Snow
- High Winds

### 8.10.1 Response

- Excavation/soil stock piles will be covered with plastic liner.
- All equipment will be shut down and secured to prevent damage.

- Personnel will be moved to safe refuge, initially crew trailers. The emergency coordinator will determine when it is necessary to evacuate personnel to off-site locations and will coordinate efforts with fire, police and other agencies.

### 8.10.2 Notification

The emergency coordinator will be responsible for assessing hazardous weather conditions and notifying personnel of specific contingency measures. Notifications will include:

- OHM employees and subcontractors
- Client Representative
- Local Emergency Management Agency

## 8.11 SPILL/RELEASE CONTINGENCY MEASURES

In the event of release or spill of a hazardous material the following measures will be taken:

### 8.11.1 Response

Any person observing a spill or release will act to remove and/or protect injured/contaminated persons from any life-threatening situation. First aid and/or decontamination procedures will be implemented as appropriate.

First aid will be administered to injured/contaminated personnel. Unsuspecting persons/vehicles will be warned of the hazard. All personnel will act to prevent any unsuspecting persons from coming in contact with spilled materials by alerting other nearby persons. Attempt to stop the spill at the source, if possible. Without taking unnecessary risks, personnel will attempt to stop the spill at the source. This may involve activities such as uprighting a drum, closing a valve or temporarily sealing a hole with a plug.

Utilizing radio communications, the emergency coordinator will be notified of the spill/release, including information on material spilled, quantity, personnel injuries and immediate life threatening hazards. Air monitoring will be implemented by the emergency coordinator and SSO to determine the potential impact on the surrounding community. Notification procedures will be followed to inform on-site personnel and off-site agencies. The emergency coordinator will make a rapid assessment of the spill/release and direct confinement, containment and control measures. Depending upon the nature of the spill, measures may include:

- Construction of a temporary containment berm utilizing on-site clay absorbent earth
- Digging a sump, installing a polyethylene liner and
- Diverting the spill material into the sump placing drums under the leak to collect the spilling material before it flows over the ground
- Transferring the material from its original container to another container

The emergency coordinator will notify the NAVY ROICC of the spill and steps taken to institute clean-up. Emergency response personnel will clean-up all spills following the spill clean-up plan developed by the emergency coordinator. Supplies necessary to clean up a spill will be immediately available on-site. Such items may include, but are not limited to:

- Shovel, rake
- Clay absorbent

- Polyethylene liner
- Personal safety equipment
- Steel drums
- Pumps and miscellaneous hand tools

The major supply of material and equipment will be located in the Support Zone. Smaller supplies will kept at active work locations. The emergency coordinator will inspect the spill site to determine that the spill has been cleaned up to the satisfaction of the ROICC. If necessary, soil, water or air samples may be taken and analyzed to demonstrate the effectiveness of the spill clean-up effort. The emergency coordinator will determine the cause of the spill and determine remedial steps to ensure that recurrence is prevented. The emergency coordinator will review the cause with the ROICC and obtain his concurrence with the remedial action plan.

# 9.0 TRAINING REQUIREMENTS

As a requirement for work at this site, in any hazardous waste work area, all field personnel will be required to take a 40-hour training class. This training must cover the requirements in 29 CFR 1910.120: personal protective equipment, toxicological effects of various chemicals, hazard communication, bloodborne pathogens, handling of unknown tanks and drums, confined-space entry procedures, electrical safety, etc. In addition, all personnel must receive annual 8-hour refresher training and three day on-site training under a trained, experienced supervisor. Supervisory personnel shall have received an additional 8-hour training in handling hazardous waste operations.

All personnel entering the exclusion zone will be trained in the provisions of this site safety plan and be required to sign the Site Safety Plan Acknowledgment in Appendix A.

Site-specific training for the Pilot Scale Treatability Study, explosives-contaminated soil, Naval Weapons Station, Yorktown, VA, which will include potential site contaminants, Hazard Communication as per 29 CFR 1910.1200, asbestos awareness training as per 29 CFR 1926.1101 (Appendix E), site physical and environmental hazards, emergency response and evacuation procedures, and emergency telephone numbers will be held at the site location by the SS and SSO before any site work activities begin.

Outlines of the orientation for OHM / OHM sub-contract personnel and visitors are presented below:

## 9.1 SITE ORIENTATION

### OHM/SUBCONTRACTORS

a. HASP sign off
b. Sign in/out procedures
c. Site background
d. Chain of command
e. Rules and regulations
f. Hours of work
g. Absences
h. Equipment
i. Emergency Information
   - Emergency signal
   - Gathering point
   - Responsibilities/roles
   - Emergency phone numbers
j. Contaminants and Material Safety Data Sheets (MSDS) [Hazard Communication Program]
k. JSAs (Phase Safety Plans)
l. Forms, site-specific
m. Asbestos awareness training

### VISITOR ORIENTATION

a. Sign in/out procedures
b. Observation platform safety
c. Review of Site map
d. Work Zones in progress

e. Hazard Communication
f. Emergency plan/signals
g. Training/medical requirements
h. Zones/areas open to visitors

# *10.0 MEDICAL SURVEILLANCE PROGRAM*

All OHM personnel participate in a medical and health monitoring program. This program is initiated when the employee starts work with a complete physical and medical history and is continued on a regular basis. A listing of OHM's worker medical profile is shown below. This program was developed in conjunction with a consultant toxicologist and OHM's occupational health physician. Other medical consultants are retained when additional expertise is required.

The medical surveillance program meets the requirements of the OSHA Standard 29 CFR 1910.120 (f).

**TABLE 10.1**
**WORKER MEDICAL PROFILE**

| Item | Initial | Annual |
|---|---|---|
| Medical History | X | X |
| Work History | X | X |
| Visual Acuity and Tonometry | X | X |
| Pulmonary Function Tests | X | X |
| Physical Examination | X | X |
| Audiometry Tests | X | X |
| Chest X-Ray | X | X |
| Complete Blood Counts | X | X |
| Blood Chem. (SSAC-23 or equivalent) | X | X |
| Urinalysis | X | X |
| Dermatology Examination | X | X |
| Electrocardiogram/Stress Test | X | X (based on age) |

Specific Tests (as required): (PCB blood or fat, urine mercury, urine arsenic, urine phenol, urine halomethanes, blood cyanide, cholinesterase-pseudo-cholesterase, nerve conduction velocity tests, blood lead, urine lead.)

## 10.1 EXAMINATION SCHEDULE

Employees are examined initially upon start of employment, annually thereafter, and may be examined upon termination of employment. Unscheduled medical examinations are conducted:

- At employee request after known or suspected exposure to toxic or hazardous materials

- At the discretion of the client, the CIH, SSO, or OHM occupational physician after known or suspected exposure to toxic or hazardous materials

- At the discretion of the OHM occupational physician

All nonscheduled medical examinations will include, as a minimum, all items specified above for periodic surveillance examination, with the exception of the chest X-ray, which will be conducted at the discretion of the occupational physician performing the examination.

# *APPENDIX A*
# *HEALTH AND SAFETY PLAN CERTIFICATION*

## HEALTH-AND-SAFETY PLAN CERTIFICATION

By signing this document, I am stating that I have read and understand the site health-and-safety plan for OHM Remediation Services Corp. personnel and visitors entering the Yorktown Naval Weapons Station site.

| *REPRESENTING* | *NAME (PRINT)* | *SIGNATURE* | *DATE* |
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# *APPENDIX B*
# *OHM HAZARD COMMUNICATION PROGRAM*

# *APPENDIX B*
# *OHM HAZARD COMMUNICATION PROGRAM*

## 1. OBJECTIVE

A Site Specific Hazard Communication (Employee Right-To-Know) Program will be instituted at the Yorktown Naval Weapons Station, Yorktown, Virginia.

## 2. PURPOSE

The purpose of Hazard Communication (Employee Right-to-Know) is to ensure that the hazards of all chemicals located at field project sites, shops, and facilities are transmitted (communicated), according to 29 CFR 1910.1200 and 29 CFR 1926.59 to all OHM personnel and OHM subcontractors.

## 3. GENERAL REQUIREMENTS

3.1 It is the responsibility of site supervisors, shop supervisors, and facilities managers to ensure that the Hazard Communication Program for the area under their supervision is updated as necessary.

3.2 Container Labeling — OHM personnel will ensure that all drums and containers are labeled according to contents. These drums and containers will include those from manufacturers and those produced by on site operations. All incoming and outgoing labels shall be checked for identity, hazard warning, and name and address of responsible party.

3.3 Material Safety Data Sheets (MSDSs) — There will be an MSDS located on site for each hazardous chemical known to exist or which is being used on site. All MSDSs will be located in the site health and safety plan which can be found in the office trailer. MSDS's for products in use may be stored in a separate binder.

3.4 Employee Information and Site Specific Training — Training employees on chemical hazards is accomplished through an ongoing corporate and regional training program. Additionally, chemical hazards will be communicated to employees through daily safety meetings held at the project and by an initial site orientation program.

3.5 OHM employees will be instructed on the following:

- Chemicals and their hazards in the work area
- How to prevent exposure to these hazardous chemicals
- What the company has done to prevent workers' exposure to these chemicals
- Procedures to follow if they are exposed to these chemicals
- How to read and interpret labels and MSDSs for hazardous substances
- Emergency spill procedures
- Proper storage and labeling

3.6 Before any new hazardous chemical is introduced on site, each employee will be given information in the same manner as during the initial safety class. The site supervisor will be responsible for seeing that the MSDS on the new chemical is available. During the mandatory morning safety briefing, information on each new chemical will be presented.

Should any new chemical be brought on site, the appropriate MSDSs will be added and reviewed with the employees.

## 1. GENERAL

The following written Hazard Communication Program has been established for OHM Remediation Services Corp. (OHM). The purpose of this program is to transmit information to the workers about the chemical hazards in the work place using various media. The transmittal of information will be accomplished by means of a comprehensive Hazard Communication Program, which will include container labeling and other forms of warning, material safety data sheets (MSDSs), and employee training in accordance with 29 CFR 1910.1200 and 29 CFR 1926.59.

Upon mobilization at the job site the Hazard Communication Program will be reviewed with all employees. Upon reading the Hazard Communication Program employees will be asked to sign the "Worker Hazard Communication Acknowledgment Form". The Hazard Communication Program will also be reviewed with new employees and visitors as they arrive on site. These persons will also be asked to sign the acknowledgment form. The Hazard Communication Program shall be available for review by anyone on site any time during normal work hours. OHM will accomplish the hazard communication requirements through formal safety training, departmental safety meetings, and job-site safety meetings.

The Health and Safety Department shall update the Hazard Communication Program when personnel responsibilities change, a new non-routine task is introduced, or an extremely hazardous material needs particular attention. This new program will then be distributed throughout the company.

## 2. RESPONSIBILITIES

Overall responsibility for compliance with the Site Specific Hazard Communication Program rests with the site supervisor. A brief outline of responsibilities for those persons directly involved with the program will follow. These responsibilities are not all inclusive, but are designed to give guidance in initial and long-term program development. Since each area is different, these responsibilities may vary.

This program is intended to cover those employees who are directly involved with the handling of hazardous chemicals or supervision of activities that involve the use of hazardous chemicals.

### 2.1 Health and Safety Department Responsibilities

- Review operations with site supervisors to determine what tasks require hazard communication training.
- Advise supervisory people as to which materials may need to be considered hazardous initially and eventually to ensure that hazard task determination is being done according to the written policy.
- Follow up through safety meetings and safety audits to ensure that supervisors are carrying out prescribed company policy.
- Notify supervisors immediately of any operating changes affecting the hazardous chemicals being used.

### 2.2 Training Department Responsibilities

- Ensure that up-to-date records are maintained on training of all employees required to handle hazardous chemicals. The supervisor should keep copies of these records and should also send copies of the initial training to the corporate training secretary for the training file.
- Educate personnel upon initial 40-hour OSHA training to the requirements of the Hazard Communication Standard.

## 2.3 Site Supervisors' Responsibilities

- Identify jobs requiring the use of hazardous chemicals and develop a list of those jobs and chemicals.
- Provide the training required by the Hazard Communication Standard and document training of employees in the safe handling of hazardous chemicals.
- Ensure inspection of engineering controls and personal protective equipment before each use. The health and safety department shall help determine a suitable inspection plan for each application as needed.
- Make daily surveys of the work area to ensure that safe practices are being followed. Advise employees of and document unsafe work practices on the first occasion and consider further unsafe work practices as disciplinary violations. Use documentation as topics of safety meetings.
- Ensure required labeling practices are being followed. Labels should be affixed to the container when it arrives. If the contents are transferred to another container, then all label information (manufacturer, manufacturer's telephone number, product name, target organ(s) and product number) must also be affixed to the new container, so that all containers of the material, regardless of size, are labeled. Contact the health and safety department for proper labels.
- Enforce all applicable safety and health standards through periodic documented audits.
- Before ordering a material, determine if a MSDS exists on file. Request a MSDS from the manufacturer for all new products.

## 2.4 Employee Responsibilities

- Read and understand entire Site Specific Hazard Communication Program.
- Obey established safety rules and regulations.
- Use all safety procedures and personal protective equipment as required by company procedures.
- Notify supervisor of the following:
  - Any symptoms or unusual effects that may be related to the use of hazardous chemicals.
  - Any missing, incomplete, or unreadable labels on containers.
  - Missing, damaged, or malfunctioning safety equipment.
- Use approved labels on containers; do not remove labels (labels are available from the health and safety department).
- Use only approved containers for hazardous chemicals. (Is chemical and container compatible and appropriate?)
- Know where emergency equipment and first-aid supplies are located.
- Know location of MSDSs. These will be located in the break/decon area and the job-site office trailer.
- Know what you are expected to do in case of an emergency. Before the commencement of any task, emergency considerations shall be made.

**2.5 Shipping/Receiving Personnel Responsibilities**

- The Project Accountant (PA) or other persons assigned by the site supervisor shall ensure MSDSs are received with initial shipment of a hazardous chemical; if not, contact purchasing to request the appropriate MSDS and also call the health and safety department to determine if there is a MSDS available until the requested MSDS arrives.
- Ensure labels with required information are affixed to all containers.
- Store hazardous materials in designated locations.
- Use proper personal protective equipment when handling hazardous chemicals.
- Report damaged containers or spills to the site supervisor and the site safety officer immediately.

## 3. HAZARD DETERMINATION

OHM will rely on MSDSs from chemical suppliers and manufacturers to meet hazard determination requirements. Other relevant data from laboratory analyses, chemical reference materials, and chemical manufacturers' written evaluation procedures will be utilized when warranted. No other method shall be used to determine a chemicals' hazards unless approved by the health and safety department.

## 4. LABELING

The site supervisor will be responsible for seeing that all containers arriving at OHM job sites are properly and clearly labeled. Site supervisors shall also check all labels for chemical identity and appropriate hazard warnings. If the hazardous chemical is regulated by OSHA in a substance specific health standard (29 CFR 1910), the site supervisor shall ensure that the labels or other forms of warning used are in accordance with the requirements of that standard. Any container that is not labeled shall be immediately labeled after initial discovery with the required information.

The site supervisor or Team Leader shall be responsible for seeing that all portable containers used in their work area are properly labeled with chemical identity and hazard warning. (Refer to MSDS for required labeling information.)

The site supervisor or Team Leader shall also ensure that labels on hazardous chemical containers are not removed or defaced unless the container is immediately marked with the required information and that all labels are legible in English and prominently displayed on the container or readily available in the work area throughout each shift.

If any container is found and the contents cannot be identified, the site supervisor shall be contacted immediately. When proper identification is made, a label shall be affixed to the container immediately. If it is discovered that no MSDS is available, the manufacturer and the health and safety department shall be contacted to assist in locating the proper MSDS. If there is no means of identifying the material in the container, the container shall be taken out of service, away from all personnel until it can be tested by the health and safety department or laboratory personnel. The site supervisor shall communicate their findings or awareness of such containers to all personnel working in the area and to the district health and safety manager.

## 5. MATERIAL SAFETY DATA SHEETS (MSDS)

The site supervisor at the job site will be responsible for maintaining a current MSDS relevant to the hazardous chemicals used on their job sites. The health and safety department will be responsible for compiling the initial MSDS file for the job site and aiding all job sites with the completion and maintenance of their respective MSDS files.

All MSDSs shall be readily available for review by all employees during each work shift. Each job site will designate a clearly marked "Employee Right-to-Know" station where employees can immediately obtain a MSDS and the required information in an emergency. MSDSs shall also be made available, upon request, to designated OHM representatives, other employer's employees, and to any OSHA inspector in accordance with the requirements of 29 CFR 1910.1200(e).

Although manufacturers are required to provide employers with MSDSs on an initial chemical shipment, OHM purchasing agents (and site supervisors purchasing their own material) shall request MSDSs and updates to MSDSs on all purchase orders. Site supervisors that are without proper MSDSs shall be responsible for requesting this information from chemical manufacturers. The site supervisor shall maintain a file of follow-up letters for all hazardous chemical shipments they receive without MSDSs.

## 6. EMPLOYEE INFORMATION AND TRAINING

It is the responsibility of the supervisor in charge of each employee to ensure that the employee is properly trained. Training employees on chemical hazards and chemical handling is accomplished at the time of initial employment at OHM, whenever a new chemical (or physical) hazard is introduced into the work area, and through ongoing formal and informal training programs. Additionally, chemical hazards are communicated to employees through weekly and morning, job- site safety meetings, which shall be documented according to topic, major points discussed, and names of those attending (attendance is mandatory). Records of all formal training conducted at OHM are coordinated and maintained by the Training Department secretary.

At a minimum, OHM will inform employees on the following:

- The requirements of 29 CFR 1910.1200--Hazard Communication--Evaluating the potential hazards of chemicals and communicating information concerning hazards and appropriate protective measures to employees. OHM shall accomplish employee training in several different ways including, but not limited, to 40-hour OSHA Hazardous Waste Worker Training (29 CFR 1910.120), shop safety meetings, job-site safety meetings, Health and Safety Department safety meetings, and formal and informal training about specific chemical hazards.

- The location and availability of the written Hazard Communication Program, list of hazardous chemicals, and MSDSs will be periodically posted on the employee bulletin boards providing the location of the above material.

- Any operations in their work area where hazardous chemicals are present.

- How to work safety with chemicals present in the workplace and minimize potential exposure.

Employee training shall include the following:

- Methods and observations that may be used to detect the presence or release of a hazardous chemical in the work area (monitoring instruments, visual appearance or odor, and acute and chronic health effects).

- The physical, chemical, and health hazards of the chemicals in the work area.

- The methods of preventing exposure to hazardous chemicals including the measures OHM has taken to protect the employees.

- Procedures to follow if OHM employees are exposed to hazardous chemicals (location of the nearest phone, emergency eyewash, and shower will be included). These discussions shall include proper operating procedures for all emergency equipment.

- The details of the OHM written Hazard Communication Program, including an explanation of the labeling system and the MSDSs, and how employees can obtain and use the appropriate hazard information.

- Procedures for workers involved in non-routine tasks.

Each site supervisor shall ensure that the above training is emphasized to OHM employees. The health and safety department will ensure that each job site is properly informing and training all employees through group meetings and individual discussions. Whenever a new hazardous chemical is placed into use, the site supervisor shall inform the employees of the hazards said chemical may pose. The site supervisor shall also be responsible for obtaining and making available a MSDS for the new chemical.

## 7. HAZARDOUS NON-ROUTINE TASKS

Occasionally, employees at OHM are required to perform tasks which are considered to be non-routine. All tasks OHM considers non-routine shall be carefully discussed among the supervisor and those performing the task. This safety briefing shall include all possible hazards an employee may encounter while completing the task, including:

- Hazard recognition
- Chemicals involved and their hazardous properties
- Physical hazards
- Methods of avoiding hazards (monitoring instruments, proper personal protective equipment, etc.)

The following is a list of some of the non-routine tasks which may occur at OHM job sites. These tasks are all covered in detail in various OHM standard operating Procedures.

7.1 Confined Space Entry
7.2 Excavation, Trenching, and Shoring
7.3 Decontamination of Equipment
7.4 Laboratory Spills
7.5 High-Pressure Washer (Laser) Operation
7.6 Line Entry Procedure
7.7 Hot Work

## 8. INFORMING CONTRACTORS

It shall be the responsibility of the OHM site supervisor/SSO to provide subcontractors with the following information:

- Hazardous chemicals to which they may be exposed while performing a task including the following:

  - Chemical properties
  - Physical properties
  - Acute/Chronic health effects

- Location of "Employee Right-to Know" station which includes the following:

  - MSDS for work area
  - Hazard Communication Program
  - Other relevant safety material such as Project Health and Safety Plan (HASP)

- Precautionary measures to be taken to protect employees from chemical and physical hazards.

- Location of nearest emergency equipment (fire extinguisher, eyewash, shower, phone, first-aid kit, etc.)

- Procedures to follow in the event of employee exposure.

- Steps OHM has taken to reduce the risk of exposure to physical and chemical hazards including the following:

  - Safety meetings
  - Hazard Communication Program
  - Proper storage and labeling of hazardous chemicals
  - Health and safety department shop audits

- The methods used to label all hazardous chemicals.

- Emergency evacuation signals and evacuation rally locations.

The health and safety department shall offer assistance in providing the above information to subcontractors working at OHM job sites. On initial visit by a subcontractor to OHM job sites, a "Contractor Right-to-Know" release form shall be completed. This form will state that the above information has been communicated to the perspective contractor.

Conversely, the site supervisor shall obtain the above information from subcontractors for hazardous materials they have brought to our projects.

### 8.1 Contractor Right-to-Know Acknowledgment

By signing this sheet, the signee is stating that an OHM employee or representative has briefed said signee on the essentials of OHM's Hazard Communication Program, including hazardous chemical(s) to which one may be exposed, location of program and MSDS, precautionary measures taken to protect contractors from chemical and physical hazards, location of nearest emergency equipment, procedures to follow in the event of employer's employee chemical exposure, and method used to label all hazardous chemicals.

| Name | Date | Company |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

## 9. LIST OF HAZARDOUS CHEMICALS

The following is a list of hazardous chemicals used on this OHM job site. Further information on each hazardous chemical listed below can be found in the MSDS which are included in the site specific health and safety plan.

- Typical OHM Job-Site Hazardous Chemical Inventory List

| Available On Site | Chemicals |
|---|---|
| _____ | Acetone |
| _____ | Acetylene |
| _____ | Activated Charcoal, Powder |
| _____ | Alum (Aluminum Sulfate) |
| _____ | Anti-fog Bausch & Lomb |
| _____ | Argon/Methan (95%/5%) |
| _____ | Brake Fluid |
| _____ | Calcium Hydroxide (Hydrated Lime) |
| _____ | Calibration Check Gas |
| _____ | Carbon |
| _____ | Caustic Soda (Sodium Hydroxide) |
| _____ | Citrikleen |
| _____ | Coal Fly Ash |
| _____ | Compressed Air |
| _____ | Diatomaceous Earth |
| _____ | Diesel Fuel |
| _____ | Dry Ice (Solid Carbon Dioxide) |
| _____ | Ethylene Glycol |
| _____ | Ferric Chloride |
| _____ | Freon |
| _____ | Gear Grease - Delta |
| _____ | Helium |
| _____ | Hexane |
| _____ | Hydraulic Fluid |
| _____ | Hydrochloric Acid |
| _____ | Hydrogen |
| _____ | Isobutylene |
| _____ | Kiln Dust |
| _____ | Methanol |
| _____ | Nitrogen |
| _____ | Nitrous Oxide |
| _____ | Oxygen |
| _____ | Penetone |
| _____ | Pentane |
| _____ | Polymers (Flocculants) |
| _____ | Premium Unleaded Gasoline |
| _____ | PVC Solvent Cleaner |
| _____ | PVC Cement |
| _____ | Regular Leaded Gasoline |
| _____ | Starting Fluid |
| _____ | Stoddard Solvent |
| _____ | Sulfuric Acid |
| _____ | 10W-40 Motor Oil - Shell |
| _____ | Tube Grease - Kendall |
| _____ | TU Type 555 Thread Sealing Compound |
| _____ | 2-Cycle Oil - Wolf's Head |

- Site-Specific Hazardous Chemical Inventory

# *APPENDIX C*
# *MATERIAL SAFETY DATA SHEETS*

# Material Safety Data Sheet

from Genium's Reference Collection

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8855

GENIUM PUBLISHING CORP.

No. 679

1,1,2-TRICHLOROETHANE

Issued: November 1988

## SECTION 1. MATERIAL IDENTIFICATION

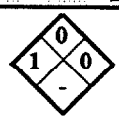
27

**Material Name:** 1,1,2-TRICHLOROETHANE

**Description (Origin/Uses):** Prepared by the catalytic chlorination of ethane or ethylene. Used as a solvent for fats, waxes, natural resins, and alkaloids.

**Other Designations:** ß-Trichloroethane; Ethane Trichloride; Vinyl Trichloride; $CH_2ClCHCl_2$; CAS No. 0079-00-5

**Manufacturer:** Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref. 73) for a list of suppliers.




Genium

HMIS

| | |
|---|---|
| H 1 | R 1 |
| F 0 | I 4 |
| R 0 | S 2 |
| PPG* | K 0 |

*See sect. 8

## SECTION 2. INGREDIENTS AND HAZARDS

| | % | EXPOSURE LIMITS |
|---|---|---|
| 1,1,2-Trichloroethane, CAS No. 0079-00-5 | Ca 100 | **OSHA PEL (Skin*)**<br>8-Hr TWA: 10 ppm, 45 mg/m³<br>**ACGIH TLV (Skin*), 1988-89**<br>TLV-TWA: 10 ppm, 45 mg/m³<br>**NIOSH REL**<br>Lowest Feasible Level<br>**Toxicity Data****<br>Rat, Oral, $LD_{50}$: 580 mg/kg<br>Rat, Inhalation, $LC_{Lo}$: 500 ppm (8 Hrs) |

*This material can be absorbed through intact skin, which contributes to overall exposure.
**See NIOSH, *RTECS* (KJ3150000), for additional data with references to irritative, tumorigenic, and mutagenic effects.

## SECTION 3. PHYSICAL DATA

**Boiling Point:** 237°F (114°C)
**Melting Point:** -33°F (-36°C)
**% Volatile by Volume:** 100
**Vapor Pressure:** 19 Torrs at 68°F (20°C)
**Molecular Weight:** 133 Grams/Mole
**Solubility in Water (%):** Insoluble
**Specific Gravity ($H_2O$ = 1):** 1.4416 at 68°F (20°C)

**Appearance and Odor:** A colorless, nonflammable liquid; sweet, pleasant odor resembling chloroform.

## SECTION 4. FIRE AND EXPLOSION DATA

| Flash Point* | Autoignition Temperature* | LEL* | UEL* |
|---|---|---|---|

**Extinguishing Media:** *1,1,2-Trichloroethane does not burn. Use an extinguishing agent such as "alcohol" foam, water spray, carbon dioxide, or dry chemical to put out the surrounding fire.

**Unusual Fire or Explosion Hazards:** None reported.

**Special Fire-fighting Procedures:** Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode to protect against the harmful effects of the surrounding fire.

## SECTION 5. REACTIVITY DATA

**Stability/Polymerization:** 1,1,2-Trichloroethane is stable in closed containers during routine operations at room temperature. Hazardous polymerization cannot occur.

**Chemical Incompatibilities:** 1,1,2-Trichloroethane can react dangerously with strong caustics such as sodium hydroxide and chemically active metals such as sodium, potassium, powdered magnesium, aluminum, and sodium-potassium alloys.

**Conditions to Avoid:** Prevent exposure to these incompatible materials.

**Hazardous Products of Decomposition:** Thermal-oxidative degradation of this liquid can produce toxic gases such as carbon monoxide (CO) and oxides of chlorine ($ClO_x$).

## SECTION 6. HEALTH HAZARD INFORMATION

**Carcinogenicity:** 1,1,2-Trichloroethane is not listed as a carcinogen by the NTP, IARC, or OSHA.
**Summary of Risks:** Inhaling 1,1,2-trichloroethane vapor or absorbing the liquid through the skin depresses the central nervous system (CNS), which can progress to narcosis. Administration of this liquid to experimental animals has produced liver damage (fatty degeneration) and has induced cancer of the liver in mice. 1,1,2-Trichloroethane is 10 to 20 times more toxic than the trichloroethylene congener. **Medical Conditions Aggravated by Long-Term Exposure:** Persons with a history of chronic respiratory, liver, or kidney disease may be at increased risk from exposure to this liquid. Preplacement questionnaires are recommended. **Target Organs:** Skin, eyes, CNS, respiratory system, liver, and kidneys. **Primary Entry:** Inhalation, skin contact/absorption. **Acute Effects:** Irritation of skin, eyes, nose, throat, and mucous membranes; and anesthesia manifested by CNS effects such as headache, dizziness, drowsiness, and incoordination. **Chronic Effects:** Liver and kidney damage and eventually coma and death may occur. Removal from exposure will reverse this progression.
**FIRST AID: Eyes.** Immediately flush eyes, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 minutes. **Skin.** Rinse the affected area with flooding amounts of water, then wash it with soap and water. **Inhalation.** Remove the exposed person to fresh air; restore and/or support his or her breathing as needed. Have qualified medical personnel administer oxygen as required. Keep the exposed person warm and at rest until medical help is available. **Ingestion.** Unlikely. **Get medical help (in plant, paramedic, community) for all exposures.** Seek prompt medical assistance for further treatment, observation, and support after first aid.

## SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

**Spill/Leak:** Notify safety personnel, evacuate unnecessary personnel, and provide adequate ventilation. Cleanup personnel should wear protective clothing and equipment (see sect. 8). Soak up the spilled 1,1,2-trichloroethane onto a suitable absorbent such as vermiculite or sawdust and place it into containers suitable for disposal. **Waste Disposal:** Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations.

**OSHA Designations**
Listed as an Air Contaminant (29 CFR 1910.1000 Subpart Z).

**EPA Designations (40 CFR 302.4)**
RCRA Waste, No. U227
CERCLA Hazardous Substance, Reportable Quantity: 1 lb (0.454 kg), per the Clean Water Act (CWA), § 307 (a); and the Resource Conservation and Recovery Act (RCRA), § 3001.

## SECTION 8. SPECIAL PROTECTION INFORMATION

**Goggles:** Always wear protective eyeglasses or chemical safety goggles. Where splashing is possible, wear a full face shield. Follow OSHA eye- and face-protection regulations (29 CFR 1910.133). **Respirator:** Use a NIOSH-approved respirator per Genium reference 88 for the maximum-use concentrations and/or the exposure limits cited in section 2. Follow OSHA respirator regulations (29 CFR 1910.134). For emergency or nonroutine operations (spills or cleaning reactor vessels and storage tanks), wear an SCBA. **Warning:** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres. **Other:** Wear impervious gloves, boots, aprons, and gauntlets, etc., to prevent skin contact with 1,1,2-trichloroethane. **Ventilation:** Install and operate general and local ventilation systems powerful enough to maintain airborne levels of this material below the OSHA PEL standard cited in section 2. Local exhaust ventilation is preferred because it prevents dispersion of the contaminant into the general work area by eliminating it at its source. Consult the latest edition of Genium reference 103 for detailed recommendations. **Safety Stations:** Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work areas. **Contaminated Equipment:** Contact lenses pose a special hazard; soft lenses may absorb irritants, and all lenses concentrate them. Do *not* wear contact lenses in any work area. Remove contaminated clothing and launder it before wearing it again; clean this material from your shoes and equipment. **Comments:** Practice good personal hygiene; always wash thoroughly after using this material and before eating, drinking, smoking, using the toilet, or applying cosmetics. Keep it off your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do *not* eat, drink, or smoke in any work area. Do not inhale 1,1,2-trichloroethane vapor.

## SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

**Storage/Segregation:** Store 1,1,2-trichloroethane in closed containers in a cool, dry, well-ventilated area away from incompatible chemicals (see sect. 5). **Special Handling/Storage:** Storage facilities must have adequate ventilation because this volatile liquid can evaporate and build up hazardous concentrations in these areas.

**Transportation Data (49 CFR 172.101-2):** Not Listed

**References:** 1, 38, 84-94, 100, 116, 117, 120, 122.





Prepared by PJ Igoe, BS
Industrial Hygiene Review: DJ Wilson, CIH
Medical Review: W Silverman, MD

## Section 6. Health Hazard Data, *Continued*

TCE crosses the placental barrier and thus exposes the fetus (any effects are yet unknown). There are increased reports of menstrual disorders in women workers and decreased libido in males at exposures high enough to cause CNS effects. TCE is eliminated unchanged in expired air and as metabolites (trichloroacetic acid & trichloroethanol) in blood and urine. **Medical Conditions Aggravated by Long-Term Exposure:** Disorders of nervous system, skin, heart, liver, and kidney. **Target Organs:** Respiratory, central & peripheral nervous, and cardiovascular (heart) systems, , kidney, and skin. **Primary Entry Routes:** Inhalation, skin and eye contact, and ingestion (rarely). **Acute Effects:** Vapor inhalation can cause eye, nose, and throat irritation, nausea, blurred vision, overexcitement, headache, drunkenness, memory loss, irregular heartbeat (resulting in sudden death), unconsciousness, and death due to cardiac failure. Skin contact with the liquid can cause dryness and cracking and prolonged exposure (generally if the victim is unconscious) can cause blistering. Eye contact can cause irritation and watering, with corneal epithelium injury in some cases. Ingestion of the liquid can cause lip, mouth, and gastrointestinal irritation, irregular heartbeat, nausea and vomiting, diarrhea (possibly blood-stained), drowsiness, and risk of pulmonary edema (fluid in lungs). **Chronic Effects:** Effects may persist for several weeks or months after repeated exposure. Symptoms include giddiness, irritability, headache, digestive disturbances, mental confusion, intolerance to alcohol (degreasers flush), altered color perception, loss or impairment of sense of smell, double vision, and peripheral nervous system function impairment including persistent neuritis, temporary loss of sense of touch, and paralysis of the fingers from direct contact with TCE liquid.

**FIRST AID** **Eyes:** *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center and unless otherwise advised, have that *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting. Do not give milk, as its fat content (TCE is lipid soluble) may inhance gastrointestinal absorption of TCE. **Note to Physicians:** TCE elimination seems to be triphasic with half lives at 20 min, 3 hr, and 30 hr. Some success is seen in treating patients with propranolol, atropine, and disulfiram. Monitor urine and blood (lethal level = 3 to 110 µg/mL) metabolites. BEI = 100 mg/g creatinine (trichloroacetic acid) in urine, *sample at end of workweek.* BEI = 4 mg/L (trichloroethanol) in blood, *sample at end of shift at end of the workweek.* These tests are not 100% accurate indicators of exposure; monitor TCE in expired air as a confirmatory test.

## Section 7. Spill, Leak, and Disposal Procedures

**Spill/Leak:** Immediately notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Shut off all ignition sources. For small spills, take up with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable container for later disposal. For large spills, flush to containment area where density stratification will form a bottom TCE layer which can be pumped and containerized. Report any release in excess of 1000 lbs. Follow applicable OSHA regulations (29 CFR 1910.120). **Ecotoxicity Values:** Bluegill sunfish, $LC_{50}$ = 44,700 µg/L/96 hr; fathead minnow (*Pimephales promelas*), $LC_{50}$ = 40.7 mg/L/96 hr. **Environmental Degradation:** In air, TCE is photooxidized with a half-life of 5 days and reported to form phosgene, dichloroacetyl chloride, and formyl chloride. In water it evaporates rapidly in minutes to hours. TCE rapidly evaporates and may leach since it does not absorb to sediment. **Soil Absorption/Mobility:** TCE has a Log $K_{oc}$ of 2, indicating high soil mobility. **Disposal:** Waste TCE can be poured on dry sand and allowed to vaporize in isolated location, purified by distillation, or returned to supplier. A potential candidate for rotary kiln incineration at 1508 to 2912 °F (820 to 1600 °C) with an acid scrubber to remove halo acids. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

**EPA Designations**

RA Extremely Hazardous Substance (40 CFR 355): Not listed
ted as a SARA Toxic Chemical (40 CFR 372.65)

**OSHA Designations**

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Listed as a RCRA Hazardous Waste (40 CFR 261.33 & 261.31): No. U228 & F002 (*spent solvent*)

Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 100 lb (45.4 kg) [* per RCRA, Sec. 3001, CWA Sec. 311 (b)(4), & CWA Sec. 307 (a)]

## Section 8. Special Protection Data

**Goggles:** Wear chemical safety goggles (cup-type or rubber framed, equipped with impact-resistant glass), per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. At any detectable concentration, wear a SCBA with a full facepiece operated in pressure demand or other positive pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets made from Viton or Neoprene to prevent skin contact. *Do not* use natural rubber or polyvinyl chloride (PVC). **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Remove this material from your shoes and clean personal protective equipment. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

## Section 9. Special Precautions and Comments

**Storage Requirements:** Prevent physical damage to containers. Store in steel drums, in a cool, dry, well-ventilated area away from sunlight, heat, ignition sources, and incompatibles (Sec. 5). Store large quantities in galvanized iron, black iron, or steel containers; small amounts in dark (amber) colored glass bottles. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. Design processes so that the operator is not directly exposed to the solvent or its vapor. Do not use open electric heaters, high-temperature processes, arc-welding or open flames in TCE atmospheres. **Administrative Controls:** Consider preplacement and periodic medical exams of exposed workers with emphasis on skin, respiratory, cardiac, central and peripheral nervous systems, and liver and kidney function. Employ air and biological monitoring (BEIs). Instruct employees on safe handling of TCE.

**Transportation Data (49 CFR 172.101)**

OT Shipping Name: Trichloroethylene
)T Hazard Class: 6.1
.) No.: UN1710
**DOT Packing Group:** III
**DOT Label:** Keep Away From Food
**DOT Special Provisions (172.102):** N36, T1

**Packaging Authorizations**
a) **Exceptions:** 173.153
b) **Non-bulk Packaging:** 173.203
c) **Bulk Packaging:** 173.241

**Quantity Limitations**
a) **Passenger Aircraft or Railcar:** 60L
b) **Cargo Aircraft Only:** 220L

**Vessel Stowage Requirements**
a) **Vessel Stowage:** A
b) **Other:** 40

*MSDS Collection* **References:** 26, 73, 100, 101, 103, 124, 126, 127, 132, 133, 136, 139, 140, 148, 149, 153, 159, 163, 164, 167, 168, 171, 174, 175, 176, 180.
**Prepared by:** M Gannon, BA; **Industrial Hygiene Review:** D Wilson, CIH; **Medical Review:** AC Darlington, MD

$(O_2N)_3C_6(OH)_3$

SYN: 2,4,6-TRINITROBENZENE-1,3,5-TRIOL

SAFETY PROFILE: Probably an eye, skin, and mucous membrane irritant. A powerful oxidant. Explodes when heated. May react with metals to form explosive salts. Upon decomposition it emits toxic fumes of $NO_x$. See also NITRO COMPOUNDS of AROMATIC HYDROCARBONS.

***TMN000*** CAS:75321-19-6 ***HR: 2***
***1,3,6-TRINITROPYRENE***
mf: $C_{16}H_7N_3O_6$ mw: 337.26

SYN: TRINITROPYRENE

TOXICITY DATA with REFERENCE
mmo-sat 1 nmol/plate CRNGDP 3,917,82
msc-ham:lng 2500 μg/L CRNGDP 3,917,82
msc-ham:ovr 200 μg/L MUREAV 119,387,83

DFG MAK: Suspected Carcinogen.

SAFETY PROFILE: Suspected carcinogen. Mutation data reported. When heated to decomposition it emits toxic fumes of $NO_x$. See also NITRO COMPOUNDS of AROMATIC HYDROCARBONS.

***.N400*** CAS:610-25-3 ***HR: 3***
***2,4,5-TRINITROTOLUENE***
mf: $C_7H_5N_3O_6$ mw: 227.15

SYN: 1-METHYL-2,4,5-TRINITROBENZENE

TOXICITY DATA with REFERENCE
mmo-sat 10 μg/plate ENMUDM 4,163,82
mma-sat 10 μg/plate ENMUDM 4,163,82
scu-mus LD20:250 mg/kg 85GMAT -,117,82

SAFETY PROFILE: Poison by subcutaneous route. Mutation data reported. Reaction with sodium carbonate forms flammable and explosive products. When heated to decomposition it emits toxic fumes of $NO_x$. See also NITRO COMPOUNDS of AROMATIC HYDROCARBONS.

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***TMN490*** CAS:118-96-7 ***HR: 3***
***2,4,6-TRINITROTOLUENE***
DOT: UN 0209/UN 1356
mf: $C_7H_5N_3O_6$ mw: 227.15

PROP: Colorless, monoclinic crystals. Mp: 80.7°, bp: 240° (explodes), flash p: explodes, d: 1.654. Sol in hot water, alc, ether.

SYNS: ENTSUFON ◇ NCI-C56155 ◇ TNT ◇ α-TNT ◇ TNT-TOLITE ◇ TOLIT ◇ TOLITE ◇ 2,4,6-TRINITROTOLUEEN (DUTCH) ◇ TRINITROTOLUENE ◇ s-TRINITROTOLUENE ◇ TRINITROTOLUENE, dry (DOT) ◇ sym-TRINITROTOLUENE ◇ s-TRINITROTOLUOL ◇ sym-TRINITROTOLUOL ◇ 2,4,6-TRINITROTOLUOL (GERMAN) ◇ TRITOL ◇ TROJNITROTOLUEN (POLISH) ◇ TROTYL ◇ TROTYL OIL

TOXICITY DATA with REFERENCE
skn-rbt 500 mg/24H MLD NTIS** AD-B011-150
mmo-sat 10 μg/plate NTIS** AD-A080-146
orl-rat TDLo:5376 mg/kg (28D male):REP JTEHD6 9,565,82
orl-hmn LDLo:28 g/kg:CNS,PUL,GIT 34ZIAG -,610,69
orl-rat LD50:795 mg/kg JTEHD6 9,565,82
orl-mus LD50:660 mg/kg JTEHD6 9,565,82
orl-cat LDLo:1850 mg/kg MRCSAB 58,32,21
scu-cat LDLo:200 mg/kg MRCSAB 58,32,21
orl-rbt LDLo:500 mg/kg MRCSAB 58,32,21
scu-rbt LDLo:500 mg/kg MRCSAB 58,32,21

CONSENSUS REPORTS: Reported in EPA TSCA Inventory. EPA Genetic Toxicology Program.

OSHA PEL: (Transitional: TWA 1.5 mg/m³ (skin)) TWA 0.5 mg/m³ (skin)
ACGIH TLV: TWA 0.5 mg/m³ (skin)
DFG MAK: 0.01 ppm (0.1 mg/m³)
DOT Classification: Class A Explosive; Label: Explosive A (UN0209); Flammable Solid; Label: Flammable Solid (UN1356).

SAFETY PROFILE: Poison by subcutaneous route. Moderately toxic by ingestion. Human systemic effects by ingestion: hallucinations or distorted perceptions, cyanosis and gastrointestinal changes. Experimental reproductive effects. Mutation data reported. A skin irritant. Has been implicated in aplastic anemia. Can cause headache, weakness, anemia, liver injury. May be absorbed through skin.

Flammable or explosive when exposed to heat or flame. Moderate explosion hazard; will detonate under strong shock. It detonates at around 240°C but can be distilled safely under reduced pressure. It is a comparatively insensitive explosive. In small quantities it will burn quietly if not confined. However, sudden heating of any quantity will cause it to detonate; the accumulation of heat when large quantities are burning will cause detonation. In other respects it is one of the most stable of all high explosives and there are but a few restrictions for its handling. It is for this reason, from the military standpoint, that TNT is quantitatively the most used. It requires a fall of 130 cm for a 2 kg weight to detonate it. It is one of the most powerful high explosives. It can be detonated by the usual detonators and blasting caps (at least a No. 6). For full efficiency, the use of a high velocity initiator, such as tetryl, is required. TNT is one of those explosives containing an oxygen deficiency. In other words, the addition of products which are oxygen-rich can enhance its explosive power. Also mono- and dinitrotoluene may be added for reduction of the temperature of the explosion and to make the explosion

flashless. Various materials are added to TNT to make what is known as permissible explosives. TNT may be regarded as the equivalent of 40% dynamite and can be used underwater. It is also used in the manufacture of a detonator fuse known as Cordeau Detonant. For the military, TNT finds use in all types of bursting charges, including armor-piercing types, although it is somewhat too sensitive to be ideal for this purpose, and has since been replaced to a great extent by ammonium picrate. It is a relatively expensive explosive and does not compete seriously with dynamite for general commercial use.

Highly dangerous; explodes with shock or heating to 297°C. Various materials can reduce the explosive temperature: red lead (to 192°C); sodium carbonate (to 218°C); potassium hydroxide (to 192°C). Mixtures with sodium dichromate + sulfuric acid may ignite spontaneously. Reacts with nitric acid + metals (e.g., lead or iron) to form explosive products more sensitive to shock, friction, or contact with nitric or sulfuric acids. Reacts with potassium hydroxide dissolved in methanol to form explosive aci-nitro salts. Bases (e.g., sodium hydroxide; potassium iodide; tetramethyl ammonium octahydrotriborate) induce deflagration in molten TNT. Can react vigorously with reducing materials. When heated to decomposition it emits highly toxic fumes of $NO_x$. See also NITRO COMPOUNDS of AROMATIC HYDROCARBONS and EXPLOSIVES, HIGH.

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***TMN500*** CAS:118-96-7 ***HR: 3***
***2,4,6-TRINITROTOLUENE (wet)***
DOT: UN 0209/UN 1356
mf: $C_7H_5N_3O_6$ mw:227.15

SYNS: TNT ◇ α-TNT ◇ TOLIT ◇ TOLITE ◇ TRINITROTOLUENE ◇ sym-TRINITROTOLUENE ◇ TRINITROTOLUENE, WET containing at least 10% water (DOT) ◇ TRINITROTOLUENE, WET containing at least 10% water, over 16 ounces in one outside packaging ◇ TRINITROTOLUENE, wetted with not less than 30% water (DOT) ◇ sym-TRINITROTOLUOL ◇ TRITOL ◇ TROTYL OIL

CONSENSUS REPORTS: Reported in EPA TSCA Inventory. EPA Genetic Toxicology Program.

DOT Classification: Class A Explosive; Label: Explosive A; Flammable Solid; Label: Flammable Solid (UN 1356).

SAFETY PROFILE: An explosive. Flammable when exposed to heat or flame. When heated to decomposition it emits toxic fumes of $NO_x$. See also NITRO COMPOUNDS of AROMATIC HYDROCARBONS and other trinitrotoluene entries.

***TMN750*** CAS:5337-41-7 ***HR: 1***
***TRIOCTADECYL BORATE***
mf: $C_{54}H_{111}BO_3$ mw: 819.46

PROP: White solid; odor of stearyl alc. Mp: 49.8- bp: 300-331° @ 0.3 mm.

SYNS: BORIC ACID, TRIOCTADECYL ESTER ◇ BORIC ACID, TRISTEARYL ESTER ◇ TRISTEARYL BORATE

TOXICITY DATA with REFERENCE
eye-rbt 100 mg MLD 14KTAK -,693,64
orl-mus LD50:6200 mg/kg 14KTAK -,693,64

SAFETY PROFILE: Mildly toxic by ingestion. An irritant. When heated to decomposition it emits a smoke and irritating fumes. See also BORON CO POUNDS and 1-OCTADECANOL.

***TMO000*** CAS:538-23-8 ***H***
***TRIOCTANOIN***
mf: $C_{27}H_{50}O_6$ mw: 470.77

SYNS: CAPRYLIC ACID TRIGLYCERIDE ◇ GLYCEROL TRICAP LATE ◇ GLYCEROL TRIOCTANOATE ◇ GLYCERYL TRIOCTANO ◇ MCT ◇ OCTANOIC ACID, 1,2,3-PROPANETRIYL ESTER ◇ OCTANOIC ACID TRIGLYCERIDE ◇ RATO ◇ TRICAPRYLIC GLYCERIDE ◇ TRICAPRYLIN ◇ TRIOCTANOYLGLYCEROL

TOXICITY DATA with REFERENCE
orl-rat TDLo:250 g/kg (7D pre-21D post):REP 1YKEDH 3,180,72
orl-rat LD50:33300 mg/kg OYYAA2 4,871,70
ipr-rat LD50:50 mg/kg NCIUS* PH 43-64-886,SEPT,65
ivn-rat LDLo:4 g/kg OYYAA2 4,871,70
orl-mus LD50:29600 mg/kg OYYAA2 4,871,70
ivn-mus LD50:3700 mg/kg APSCAX 40,338,57
ipr-rbt LDLo:3400 mg/kg JNCIAM 54,1439,75

CONSENSUS REPORTS: Reported in EPA TSCA ventory. EPA Genetic Toxicology Program.

SAFETY PROFILE: Poison by intraperitoneal ro Moderately toxic by intravenous route. Mildly toxic ingestion. Experimental reproductive effects. W heated to decomposition it emits acrid smoke and irri ing fumes. See also ESTERS.

***TMO250*** CAS:2467-12-1 ***H***
***TRI-n-OCTYL BORATE***
mf: $C_{24}H_{51}BO_3$ mw: 398.56

PROP: Colorless liquid; odor of octyl alc. Bp: 192-1 @ 2 mm, flash p: 370°F (COC), d: 0.846 @ 23°, vap 13.7.

SYN: BORIC ACID, TRI-n-OCTYL ESTER

TOXICITY DATA with REFERENCE
eye-rbt 100 mg MOD 14KTAK -,693,64
orl-mus LD50:1290 mg/kg 14KTAK -,693,64

CONSENSUS REPORTS: Reported in EPA TSCA ventory.

SAFETY PROFILE: Moderately toxic by ingestion.

***CPR800*** CAS:121-82-4 ***HR: 3***
***CYCLONITE***
DOT: UN 0072/UN 0118
mf: $C_3H_6N_6O_6$ mw: 222.15

PROP: White, crystalline powder. Mp: 202°.

SYNS: CYCLOTRIMETHYLENENITRAMINE ◇ CYCLOTRIMETHYLENETRINITRAMINE ◇ CYCLOTRIMETHYLENETRINITRAMINE, containing at least 10%-25% water (DOT) ◇ CYCLOTRIMETHYLENETRINITRAMINE, desensitized (DOT) ◇ ESAIDRO-1,3,5-TRINITRO-1,3,5-TRIAZINA (ITALIAN) ◇ HEKSOGEN (POLISH) ◇ HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZIN (GERMAN) ◇ HEXAHYDRO-1,3,5-TRINITRO-s-TRIAZINE ◇ HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE ◇ HEXOGEEN (DUTCH) ◇ HEXOGEN (explosive) ◇ HEXOGEN 5W ◇ HEXOLITE ◇ HEXOLITE, dry or containing, by weight, less than 15% water (DOT) ◇ PBX(AF) 108 ◇ RDX ◇ TRIMETHYLEENTRINITRAMINE (DUTCH) ◇ TRIMETHYLENETRINITRAMINE ◇ sym-TRIMETHYLENETRINITRAMINE ◇ TRINITROCYCLOTRIMETHYLENE TRIAMINE ◇ 1,3,5-TRINITRO-1,3,5-TRIAZACYCLOHEXANE

TOXICITY DATA with REFERENCE
orl-rat TDLo:3 g/kg (13W male/13W pre-22D preg):REP NTIS** AD-A092-531
orl-rat TDLo:20 mg/kg (female 6-15D post):TER NTIS** AD-A166-249
orl-rat LD50:100 mg/kg TXAPA9 39,531,77
ipr-rat LDLo:10 mg/kg EATR** EB-TR-73040
ivn-rat LDLo:18 mg/kg EATR** EB-TR-73040
mus LD50:59 mg/kg NTIS** AD-A092-531
-mus LD50:19 mg/kg EATR** EB-TR-73040
orl-cat LDLo:100 mg/kg FATOAO 7,43,44
orl-rbt LDLo:500 mg/kg FATOAO 7,43,44
ivn-gpg LD50:25 mg/kg EATR** EB-TR-73040

CONSENSUS REPORTS: Reported in EPA TSCA Inventory.

OSHA PEL: TWA 1.5 mg/m$^3$ (skin)
ACGIH TLV: TWA 1.5 mg/m$^3$ (skin)
DOT Classification: Class A Explosive; Label: Explosive A, Corrosive.

SAFETY PROFILE: Poison by ingestion, intraperitoneal, and intravenous routes. An experimental teratogen. Other experimental reproductive effects. A corrosive irritant to skin, eyes, and mucous membranes. Cases of epileptiform convulsions have been reported from exposure. It is one of the most powerful high explosives in use today. Has more shattering power than TNT and is often mixed with TNT as a bursting charge for aerial bombs, mines, and torpedoes. It is easily initiated by mercury fulminate which may be used as a booster. When heated to decomposition it emits toxic fumes of $NO_x$. See also AMINES, NITRATES, and EXPLOSIVES, HIGH.

***CPR825*** CAS:1552-12-1 ***HR: 2***
***cis,cis-CYCLOOCTA-1,5-DIENE***
mf: $C_8H_{12}$ mw: 108.20

SYNS: COD ◇ 1,5-CYCLOOCTADIENE (Z,Z)

TOXICITY DATA with REFERENCE
skn-mus 100%/12D open SEV BJIMAG 25,75,68
skn-rbt 2640 mg SEV BJIMAG 25,75,68
skn-rbt 20 g/31D-I open SEV BJIMAG 25,75,68
eye-rbt 88 mg MLD BJIMAG 25,75,68
skn-gpg 10 g/31D-I open SEV BJIMAG 25,75,68

SAFETY PROFILE: An eye and severe skin irritant. When heated to decomposition it emits acrid smoke and fumes.

***CPR840*** CAS:12245-39-5 ***HR: 3***
***(1,5-CYCLOOCTADIENE)(2,4-PENTANEDIONATO)RHODIUM***
mf: $C_{13}H_{19}O_2Rh$ mw: 310.23

SYNS: ACETYLACETONATE-1,5-CYCLOOCTADIENERHODIUM ◇ RHODIUM, ((1,2,5,6-eta)-1,5-CYCLOOCTADIENE)(2,4-PENTANEDIONATO-O,O')- ◇ RHODIUM, (1,5-CYCLOOCTADIENE)(2,4-PENTANEDIONATO)-

TOXICITY DATA with REFERENCE
ipr-mus LD50:34 mg/kg CBINA8 45,1,83

OSHA PEL: TWA 0.1 mg(Rh)/m$^3$
ACGIH TLV: TWA 1 mg(Rh)/m$^3$

SAFETY PROFILE: Poison by intraperitoneal route. When heated to decomposition it emits toxic fumes of Rh.

***CPS000*** CAS:115-25-3 ***HR: 1***
***CYCLOOCTAFLUOROBUTANE***
DOT: UN 1976
mf: $C_4F_8$ mw: 200.03

PROP: Colorless, odorless gas. Bp: −6.04°, mp: −41.4°, d (liquid): 1.513 @ −70°F.

SYNS: FC-C 318 ◇ FREON C-318 ◇ HALOCARBON C-138 ◇ OCTAFLUOROCYCLOBUTANE (DOT) ◇ PERFLUOROCYCLOBUTANE ◇ PROPELLANT C318 ◇ R-C 318

TOXICITY DATA with REFERENCE
sln-dmg-ihl 99 pph/10M ENVRAL 7,275,74

CONSENSUS REPORTS: EPA Genetic Toxicology Program. Reported in EPA TSCA Inventory.

DOT Classification: Nonflammable Gas; Label: Nonflammable Gas.

SAFETY PROFILE: Mildly toxic by ingestion and inhalation. Can cause slight transient effects at high concentrations. No anesthesia or central nervous system effects. Nonflammable Gas. Mutation data reported. When

scu-dog LDLo:2000 mg/kg ANTCAO 6,708,56
scu-mky LDLo:4000 mg/kg ANTCAO 6,708,56

CONSENSUS REPORTS: EPA Genetic Toxicology Program.

SAFETY PROFILE: Poison by intraperitoneal route. Moderately toxic by intravenous and subcutaneous routes. Mildly toxic by ingestion. Human systemic effects by ingestion and possibly other routes: wakefulness, sleep, altered sleep time, hallucinations, distorted perceptions, tremors, convulsions, and coma. An antibiotic used in the treatment of human pulmonary tuberculosis. When heated to decomposition it emits toxic fumes of $NO_x$.

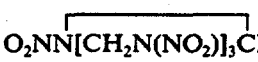
***CQH100*** CAS:59865-13-3 ***HR: 2***
***CYCLOSPORIN A***
mf: $C_{62}H_{111}N_{11}O_{12}$ mw: 1202.84

SYNS: ANTIBIOTIC S 7481F1 ◇ CICLOSPORIN ◇ CYCLOSPORIN ◇ CYCLOSPORINE ◇ CYCLOSPORINE A ◇ OL 27-400 ◇ S 7481F1 ◇ SANDIMMUN ◇ SANDIMMUNE

TOXICITY DATA with REFERENCE
sce-hmn:lyms 1 mg/L IGAYAY 134,403,85
ims-rbt TDLo:210 mg/kg (14D pre):REP INJFA3 29,218,84
orl-man TDLo:259 mg/kg/2W-C:CAR CEDEDE 8,159,83
orl-wmn TDLo:62500 µg/kg/5D-I:SYS LANCAO 1,1221,86
orl-man TDLo:20 mg/kg/2D-I:BLD LANCAO 2,1092,86
unr-man TDLo:30 mg/kg/4D-I:SYS AIMEAS 107,786,87
orl-rat LD50:1489 mg/kg IYKEDH 17,365,86
ipr-rat LD50:147 mg/kg IYKEDH 17,365,86
scu-rat LD50:286 mg/kg IYKEDH 17,365,86
ivn-rat LD50:24 mg/kg IYKEDH 17,365,86
orl-mus LD50:2803 mg/kg IYKEDH 17,365,86
ivn-mus LD50:96 mg/kg IYKEDH 17,365,86
ivn-rbt LD50:10 mg/kg TOPADD 14,73,86

SAFETY PROFILE: Questionable human carcinogen producing Hodgkin's disease. Experimental carcinogenic data. Experimental reproductive effects. Poison by intraperitoneal and intravenous routes. Moderately toxic by ingestion. Human systemic effects by ingestion: increased body temperature, cyanosis. Mutation data reported. When heated to decomposition it emits toxic fumes of $NO_x$.

***CQH250*** CAS:2691-41-0 ***HR: 3***
***CYCLOTETRAMETHYLENE TETRANITRAMINE***
DOT: UN 0226
mf: $C_4H_8N_8O_8$ mw: 296.20



SYNS: CYCLOTETRAMETHYLENE TETRANITRAMINE, dry (DOT) ◇ HMX (DOT) ◇ beta HMY ◇ HW 4 ◇ LX 14-0 ◇ OCTOGEN ◇ OKTOGEN ◇ TETRAMETHYLENETETRANITRAMINE ◇ 1,3,5,7-TETRANITROPERHYDRO-1,3,5,7-TETRAZOCINE

TOXICITY DATA with REFERENCE
orl-mus LD50:1500 mg/kg GISAAA 40(11),17,75
ivn-dog LDLo:40 mg/kg EATR** EB-TR-73040
orl-gpg LD50:300 mg/kg GISAAA 40(11),17,75
ivn-gpg LD50:28 mg/kg EATR** EB-TR-73040

CONSENSUS REPORTS: Reported in EPA TSCA Inventory.

DOT Classification: Forbidden, Dry; Class A Explosive: Label: Explosive A, wet.

SAFETY PROFILE: A poison by ingestion and intravenous routes. An explosive. Decomposes violently at 279°C. When heated to decomposition it emits toxic fumes of $NO_x$. See also EXPLOSIVES, HIGH.

***CQH325*** CAS:860-79-7 ***HR: 3***
***CYCLOVIROBUXINE D***
mf: $C_{26}H_{46}N_2O$ mw: 402.74

SYNS: BEBUXINE ◇ CYCLOVIROBUXIN D ◇ CYCLOVIROBUXINE

TOXICITY DATA with REFERENCE
orl-mus LD50:293 mg/kg CYLPDN 3,101,82
ipr-mus LD50:9200 µg/kg CYLPDN 3,101,82
ivn-mus LD50:8900 µg/kg CYLPDN 3,101,82

SAFETY PROFILE: Poison by ingestion, intravenous and intraperitoneal routes. When heated to decomposition it emits toxic fumes of $NO_x$.

***CQH500*** CAS:126-02-3 ***HR: 3***
***CYCRIMINE HYDROCHLORIDE***
mf: $C_{19}H_{29}NO{\bullet}ClH$ mw: 323.95

SYNS: COMPOUND 8958 ◇ α-CYCLOPENTYL-α-PHENYL-1-PIPERIDINEPROPANOL HYDROCHLORIDE ◇ PAGITANE HYDROCHLORIDE ◇ 1-PHENYL-1-CYCLOPENTYL-3-PIPERIDINO-1-PROPANOL HYDROCHLORIDE

TOXICITY DATA with REFERENCE
orl-rat LD50:628 mg/kg 27ZQAG -,218,72
orl-mus LD50:349 mg/kg 27ZQAG -,218,72
ipr-mus LD50:250 mg/kg NTIS** AD691-490
ivn-mus LD50:50 mg/kg 27ZQAG -,218,72

SAFETY PROFILE: Poison by ingestion, intraperitoneal, and intravenous routes. When heated to decomposition it emits very toxic fumes of HCl and $NO_x$.

***CQH625*** CAS:7199-29-3 ***HR: 2***
***CYHEPTAMIDE***
mf: $C_{16}H_{15}NO$ mw: 237.29

PROP: Long needles from acetonitrile. Mp: 193-194°



Sol in chloro
sltly sol in eth

SYNS: AY 8682
: DIBENZO(a,d)(
: DIBENZO(a,d)(
DIHYDRO-5H-DI
: ICI 51426

TOXICITY I
orl-rat LD50:
ipr-rat LD50:
orl-mus LD5(
ipr-mus LD5(

SAFETY PR(
intraperitonea
to decomposi

***CQH650***
***CYHEXATI***
mf: $C_{18}H_{34}OS$

SYNS: DOWCO
: PLYCTRAN ◇ T
: TRICYCLOHEX
OXIDE ◇ TRIC

TOXICITY D
orl-rat TDLo:
orl-rat LD50:
ihl-rat LC50:2
skn-rat LD50:
ipr-rat LD50:
orl-rbt LD50:
skn-rbt LD50:
orl-gpg LD50:
orl-ckn LD50:
orl-dom LDL(

OSHA PEL: T
ACGIH TLV
STEL 0.2 mg/
NIOSH REL
mg(Sn)/m³.

SAFETY PR(
and intraperit
contact. Exp
heated to deco
ing fumes. See

***CQH750***
***CYMARIN***
mf: $C_{30}H_{44}O_9$

SYNS: CYMARI
9-OXO-5-β-CARD-
TOSID (GERMAN)

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***Material Safety Data Sheets Collection:***

**Sheet No. 312**
**Trichloroethylene**

Issued: 7/79 Revision: F, 9/92

## Section 1. Material Identification



**Trichloroethylene ($C_2HCl_3$) Description:** Derived by treating tetrachloroethane with lime or other alkali in the presence of water, or by thermal decomposition of tetrachloroethane followed by steam distillation. Stabilizers such as epichlorohydrin, isobutanol, carbon tetrachloride, chloroform, benzene, or pentanol-2-triethanolamine are then added. Used as a degreasing solvent in electronics and dry cleaning, a chemical intermediate, a refrigerant and heat-exchange liquid, and a diluent in paint and adhesives; in oil, fat, and wax extraction and in aerospace operations (flushing liquid oxygen). Formerly used as a fumigant (food) and anesthetic (replaced due to its hazardous decomposition in closed-circuit apparatus).

**Other Designations:** CAS No. 79-01-6; acetylene trichloride; Algylen; Anamenth; Benzinol; Cecolene; Chlorylen; Dow-Tri; ethylene trichloride; Germalgene; Narcogen; Triasol; trichloroethene; TCE; 1,1,3-trichloroethylene.

**Manufacturer:** Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

R 1
I 2
S 2*
K 3
* Skin absorption

NFPA


HMIS
H 2†
F 2
R 0
PPE‡
† Chronic Effects
‡ Sec. 8

**Cautions:** TCE is irritating and toxic to the central nervous system (CNS). Inhalation of high concentrations have lead to death due to ventricular fibrillation. Chronic exposure may lead to heart, liver, and kidney damage. The liquid is absorbed through the skin. Although it has a relatively low flash point, TCE burns with difficulty.

## Section 2. Ingredients and Occupational Exposure Limits

Trichloroethylene, < 100% [contains stabilizers (Sec. 1)].

**1991 OSHA PELs**
8-hr TWA: 50 ppm (270 mg/m³)
15-min STEL: 200 ppm (1080 mg/m³)

**1990 IDLH Level**
1000 ppm

**1990 NIOSH REL**
10-hr TWA: 25 ppm (~135 mg/m³)

**1992-93 ACGIH TLVs**
TWA: 50 ppm (269 mg/m³)
STEL: 200 ppm (1070 mg/m³)

**1990 DFG (Germany) MAK**
Ceiling: 50 ppm (270 mg/m³)
Category II: Substances with systemic effects
Half-life: 2 hr to shift length
Peak Exposure Limit: 250 ppm, 30 min average value; 2 peaks/shift

**1985-86 Toxicity Data***
Human, inhalation, $TC_{Lo}$: 160 ppm/83 min caused hallucinations and distorted perceptions.
Human, lymphocyte: 5 mL/L caused DNA inhibition.
Rabbit, skin: 500 mg/24 hr caused severe irritation.
Rabbit, eye: 20 mg/24 hr caused moderate irritation.
Mouse, oral, $TD_{Lo}$: 455 mg/kg administered intermittently for 78 weeks produced liver tumors.

* See NIOSH, *RTECS* (KX4550000), for additional irritation, mutation, reproductive, tumorigenic and toxicity data.

## Section 3. Physical Data

**Boiling Point:** 189 °F (87 °C)
**Freezing Point:** -121 °F (-85 °C)
**Viscosity:** 0.0055 Poise at 77 °F (25 °C)
**Molecular Weight:** 131.38
**Density:** 1.4649 at 20/4 °C
**Refraction Index:** 1.477 at 68 °F (20 °C/D)
**Odor Threshold:** 82 to 108 ppm (*not an effective warning*)

**Vapor Pressure:** 58 mm Hg at 68 °F (20 °C); 100 mm Hg at 32 °F (0 °C)
**Saturated Vapor Density (Air = 0.075 lbs/ft³; 1.2 kg/m³):** 0.0956 lbs/ft³; 1.53 kg/m³
**Water Solubility:** Very slightly soluble; 0.1% at 77 °F (25 °C)
**Other Solubilities:** Highly soluble in organic solvents (alcohol, acetone, ether, carbon tetrachloride, & chloroform) and lipids.
**Surface Tension:** 29.3 dyne/cm

**Appearance and Odor:** Clear, colorless (sometimes dyed blue), mobile liquid with a sweet chloroform odor.

## Section 4. Fire and Explosion Data

**Flash Point:** 90 °F (32 °C) CC | **Autoignition Temperature:** 788 °F (420 °C) | **LEL:** 8% (25 °C); 12.5% (100 °C) | **UEL:** 10% (25 °C); 90% (100 °C)

**Extinguishing Media:** A Class 1C Flammable Liquid. Although it has a flash point of 90 °F, TCE burns with difficulty. For small fires, use dry chemical, carbon dioxide, water spray, or regular foam. For large fires, use water spray, fog, or regular foam. **Unusual Fire or Explosion Hazards:** Vapor/air mixtures may explode when ignited. Container may explode in heat of fire. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighters' protective clothing provides only limited protection against TCE. Apply cooling water to sides of container until well after fire is out. Stay away from ends of tanks. Do not release runoff from fire control methods to sewers or waterways.

## Section 5. Reactivity Data

**Stability/Polymerization:** TCE slowly decomposes in the presence of light and moisture to form corrosive hydrochloric acid. Hazardous polymerization cannot occur. **Chemical Incompatibilities:** Include alkalis (sodium hydroxide), chemically active metals (aluminum, beryllium, lithium, magnesium, sodium, potassium, and titanium), epoxides, and oxidants (nitrogen tetraoxide, perchloric acid). Contact with 1-chloro-2,3-epoxy propane or the mono and di 2,3-epoxypropyl ethers of 1,4-butanediol + 2,2-bis-4(2',3'-epoxypropoxy)-phenylpropane can, in the presence of catalytic quantities of halide ions, cause dehydrochlorination of TCE to explosive dichloroacetylene. **Conditions to Avoid:** Exposure to light, moisture, ignition sources, and incompatibles. **Hazardous Products of Decomposition:** Thermal oxidative decomposition of TCE (above 300 °C) or exposure to ultraviolet light can produce carbon dioxide ($CO_2$) and toxic dichloro acetylene (explosive), chlorine, hydrogen chloride, and phosgene gas.

## Section 6. Health Hazard Data

**Carcinogenicity:** The following agencies have rated TCE's carcinogenicity: IARC (Class 3, limited animal evidence & insufficient human data), Germany MAK (Class B, justifiably suspected of having carcinogenic potential), & NIOSH (Class X, carcinogen defined with no further categorization). **Summary of Risks:** TCE vapor is irritating to the eyes, nose, and respiratory tract and inhalation of high concentrations can lead to severe CNS effects such as unconsciousness, ventricular arrythmias, and death due to cardiac arrest. Mild liver dysfunction was also seen at levels high enough to produce CNS effects. Contact with the liquid is irritating to the skin and can lead to dermatitis by defatting the skin. Chronic toxicity is observed in the victims increasing intolerance to alcohol characterized by 'degreasers flush', a transient redness of the face, trunk, and arms. The euphoric effect of TCE has led to craving, and habitual sniffing of its vapors.

*Continue on next page*

# *APPENDIX D*
# *SITE-SPECIFIC PERSONAL PROTECTIVE EQUIPMENT (PPE) PROGRAM*

## 1. OBJECTIVE

OHM Remediation Services Corp. (OHM) personnel will be protected for chemical, physical, and environmental hazards by the appropriate personal protective equipment (PPE) when engineering and administrative controls are not effective in controlling job hazards.

## 2. PURPOSE

The purpose of this procedure is to address the elements of the PPE program. This PPE program conforms to the requirements found in 29 CFR 1910.120 (g) Engineering controls, work practices, and personal protective equipment for employee protection; 29 CFR 1910 Subpart I - Personal Protective Equipment - .132 General Requirements, .133 Eye and Face Protection, .135 Head Protection, .136 Foot Protection, .138 Hand Protection; and 29 CFR 1910.1200 Hazard Communication.

## 3. RESPONSIBILITY AND AUTHORITY

The responsibility and authority for the selection, use, and maintenance of personal protective equipment is shared between management, supervisory, health and safety, and employee personnel.

3.1 Management - Management has the responsibility to provide PPE appropriate for the hazard/s associated with expected work tasks.

3.2 Supervisors - Supervisors have the responsibility to conduct hazard assessments and ensure personnel to utilize PPE in compliance with this SOP. Supervisors may request assistance from or designate authority to health and safety personnel for hazard assessment, selection, inspection, and decontamination of PPE. The use of PPE by employees is the supervisor's responsibility.

3.3 Health and Safety Personnel - Health and safety personnel have the responsibility to assist supervisors in hazard assessment, selection, inspection, and decontamination of PPE. In the event of conflict, health and safety personnel have the authority to implement the necessary measures.

3.4 Employees - Employees have the responsibility to use, inspect, and decontaminate PPE as directed by supervisors.

## 4. PROGRAM ELEMENTS

Program elements define the regulatory requirements of a PPE program.

4.1 Hazard assessment - All tasks undertaken by OHM personnel will be assessed for chemical, physical, and environmental hazards present or likely to be present which necessitate the use of PPE to ensure adequate protection. This assessment shall take place prior to commencement of work.

4.2 Hazard Reassessment - The level of protection or type of personal protective equipment shall be increased when additional information on site conditions indicates that increased protection is necessary to reduce employee exposures below permissible exposure limits, published exposure levels for hazardous substances and health hazards, or other physical and environmental hazards.

4.3 PPE Selection - The regional health and safety director/manager or designee will initially select the level and types of PPE that will protect the affected employee from the hazards identified in the initial hazard assessment.

4.4 Written Certification - The site specific Health and Safety Plan (HASP) will serve as the written certification that identifies the workplace was evaluated. The HASP shall be dated. The signature line shall designate the person certifying that the evaluation has been performed.

4.5 Communication of Selection - Employees will be informed of the PPE selection decisions through reading or verbally reviewing the HASP, attending pre-project safety briefings, job safety analysis (JSA) review, or attending safety meetings.

4.6 PPE Use and Fit - The supervisor will be responsible for the proper use and fit of PPE by workers under their direction and will monitor the effectiveness of these items. Heath and safety personnel will advise and assist the supervisor in these areas.

4.7 Work Mission Duration - The supervisor will be responsible for the establishment of the duration of specific work missions. The duration will be determined by the complexity of the assignment, PPE involved, physical factors, temperature, humidity, weather conditions, elevation of work, and acclimation of the worker to the demands of the task assigned. The supervisor will consider the recommendations of the health and safety personnel.

A sufficient amount of rest breaks will be allowed in order to avoid overexertion or thermal stress by the employees while maintaining productive work practices. Further guidance is offered in OHM Health and Safety Procedures entitled Heat Stress and Cold Stress.

4.8 PPE Maintenance and Storage - Each employee is responsible for the proper maintenance and storage of the standard issue equipment (e.g., hard hat, full-face piece negative pressure respirator, safety glasses). The supervisor will assure that proper maintenance is carried out.

4.9 PPE Decontamination - Each employee is responsible for daily cleaning and decontamination of reusable PPE such as outer gloves, outer boots, reusable chemically resistant clothing, and standard issue PPE such as hard hats and respirators.

OHM will provide an area/s for decontamination operations, necessary cleaning agents, cleaning tools, such as brushes and wash basins, and a method to dispose of materials generated during decontamination activities.

OHM will attempt to reduce decontamination requirements through the use of disposable protective clothing and gloves as feasible.

4.10 PPE Training - All employees will receive training in the proper use of PPE prior to wearing the equipment in a work situation. This training will be administered upon commencement of employment during HAZWOPER training. PPE refresher training will be reviewed annually during the HAZWOPER refresher training. Project specific training will be provided as required.

4.11 PPE Donning and Doffing Procedures - All employees will receive training upon commencement of employment and during annual refresher training concerning the donning and doffing of PPE. Periodic training will be provided as required.

4.12 PPE Inspection - Each employee shall inspect PPE for defects and proper function prior to each use. Defective or damaged PPE shall not be used. Any PPE found to be defective or have missing parts will be replaced prior to use.

4.13 PPE In Use Monitoring - The supervisor is responsible for monitoring the effectiveness of selected PPE. If at any time level of PPE is to be downgraded, it is mandatory that the change be approved by the regional health and safety director/manager or designee.

4.14 Evaluation of PPE Program - Health and safety personnel will compile data on PPE in the field to determine that the PPE performs to OHM needs. Periodically, this information should be reviewed cognizant health and safety professional to ensure that PPE is providing the necessary level of protection, quality, and is appropriate for the work performed.

If at any time the failure of PPE causes injury to an employee or fails to perform as expected, the supervisor will take the unit or item out of service and investigate the incident. The incident shall be immediately reported to the regional health and safety director/manager. If after scrutiny, the unit or item is determined to have a manufacturing defect, all identical units will be removed from use until corrective actions are taken.

4.15 Limitations During Temperature Extremes - Extreme temperatures exert stress on personnel and may alter the performance characteristics of PPE. During periods of extreme temperature, work assignments will be adjusted to protect the employee from overexertion or exposure. The supervisor will evaluate if temperature extremes are effecting performance characteristics of PPE and report these findings to the regional health and safety director/manager.

4.16 Unserviceable PPE - Any PPE which is no longer functioning properly or is no longer serviceable shall be removed from use and either repaired or destroyed.

## 5. SAFETY EQUIPMENT POLICY

OHM will provide, maintain, and replace personal protective equipment as detailed below.

5.1 Standard issue safety equipment - Standard issue safety equipment will be provided at no cost to field employees. These items consist of:

- Hard hat
- Safety glasses with clear and shaded lenses
- Full-face respirator with nose cup

5.2 Company provided equipment - OHM will provide at no cost to the employee the following items on a task specific or project specific basis:

- Chemical protective equipment such as gloves, boots, and clothing
- Specialty glasses or goggles

- Face shields
- Flame resistant clothing
- Hearing protection
- Fall protection

5.3 Employee provided equipment - The employee shall provide the following equipment:

- ANSI approved steel toed and shank boots/shoes (Note: Further guidance is provided in Section 7 Safety footwear)
- Outerwear for cold weather

5.4 Equipment replacement - OHM will replace worn-out or work-damaged equipment detailed in 5.1 and 5.2. OHM reserves the right to charge employees for the replacement cost of equipment which is lost or damaged though neglect or abuse.

5.5 Additional PPE - The regional health and safety director/manager or the supervisor may require additional company provided PPE on a task specific basis.

## 6. WORK CLOTHES

OHM employees, subcontractors, and visitors will observe the requirements for proper work clothing when on OHM project sites, facilities, and shops.

6.1 Pants - Long pants are required at all times. These pants must be in good repair.

6.2 Shirts - Shirts will be worn on the job. Shirts will be buttoned up the front and at the cuff unless rolled up. Shirt tails must be kept in the trousers. Sleeveless shirts are prohibited at all work locations. Supervisory personnel are expected to wear a shirt with a collar. T-shirts are permitted for personnel who wear protective clothing most of the day.

6.3 Clothing - Loose or ragged clothing will not be worn.

6.4 Modifications - Regional health and safety director/manager may modify work clothing requirements on a project specific basis.

6.5 Contaminated Clothing - Clothing (including shoes) saturated with petroleum products or chemicals will be removed immediately to prevent irritation and possible dermal exposure.

6.6 Jewelry - Rings and other jewelry (except watches) must be removed when working in areas where they could catch on moving objects, sharp protrusions, come in contact with electrical circuits or chemical agents, or compromise PPE ie. rings capable of cutting gloves. Additionally, the supervisor may deem other types of jewelry inappropriate for the work task.

6.7 Hair Length - Hair long enough to constitute a hazard while working around moving machinery or rotating tools and equipment must be secured by a net or tied back. Hair styles must not interfere with the ability to properly wear safety headgear, safety spectacles, and respiratory protection.

## 7. EYE/FACE PROTECTION

All OHM employees, subcontractors, and visitors shall wear eye and face protection meeting the requirements of ANSI document Z87.1 - 1989 titled "Practice of Occupational and Educational Eye and Face Protection" during the tasks posing exposure to eye or face injury.

7.1 Requirements - To protect the face and eyes against injuries from flying objects, splashing liquids, and harmful rays, safety spectacles with side shields, goggles, face shields, cutting goggles, and welding helmets will be used as appropriate. The supervisor will be responsible to identify the need for eye/face protection and specify the eye/face protection required for each operation. A selection guide is attached in Table 1.

7.2 Safety spectacles - Safety spectacles are protective devices intended to shield the wearer's eyes from a variety of hazards. While they are primary protectors and may be used alone, they may also be used in conjunction with other protective devices such as goggles and face shields.

7.3 Goggles - Goggles are protective devices intended to fit the face immediately surrounding the eyes in order to shield the eyes from a variety of hazards. While they are primary protectors and may be used alone, they also may be used in conjunction with other protectors.

7.4 Face shields - Face shields are protective devices intended to shield the wearer's face, or portions thereof, in addition to the eyes, from certain hazards. Face shields are secondary protectors and shall be used with primary protectors.

7.5 Cutting goggles - Cutting goggles are protective devices designed to protect the eyes from radiation and impact. Goggles are primary protectors and in some situations must be supplemented with face shields. See Table 2 for selection guidelines.

7.6 Welding helmets - Welding helmets are protective devices intended to shield the eyes and face from optical radiation and impact. Welding helmets are secondary protectors and shall be used only in conjunction with primary protectors such as safety spectacles or goggles. See Table 3 for selection guidelines.

7.7 Prescription Spectacles - For personnel that wear prescription spectacles, OHM provides prescription safety spectacles with side shields. It is mandatory that prescription safety spectacles not be altered by the employee and be worn at all times when safety spectacles are required.

7.8 Contact lenses - Contact lenses are not permitted to be worn where accidental eye contact with chemical agents or physical materials is possible. OHM provides prescription spectacles and other protective devices for use in these situations.

7.9 Shaded lenses - Shaded lenses are not to be worn indoors or under low light conditions.

8. SAFETY HEADGEAR

All OHM employees, subcontractors, and visitors shall wear safety headgear meeting the requirements of ANSI document Z89.1-1986 titled "Protective Headwear for Industrial Workers - Requirements" when exposed to overhead hazards.

8.1 Requirement - Safety headgear shall be worn by all personnel while engaged in work where there is a hazard of falling objects, low overhead restrictions, and other overhead hazards exist. Safety headgear may also be required to be worn by contractual requirements.

8.2 Use - Safety headgear must be worn as prescribed by the manufacturer in the bill front position unless the headgear was approved to be worn in another position.

8.3 Modifications - Safety headgear shall not be painted, drilled or modified in any manner. Use of safety related headgear stickers are permitted.

8.4 Life Expectancy - No maximum mandatory service life is specified by regulation for safety headgear. However, a hard hat should be removed from service if chemical corrosion, cracks, deformities, worn suspension, or discoloration is noted with the unit.

9. SAFETY FOOTWEAR

All OHM employees, subcontractors, and visitors that enter OHM project sites and are exposed to foot hazards shall wear footwear meeting the ANSI document Z41 - 1991 titled "Protective Footwear" during operations posing foot injury.

9.1 Project Sites - Steel toe and shank leather work boots shall be worn on all OHM project sites. High top or low top sneakers, western style boots, or other footwear even though ANSI approved are not appropriate for the activities encountered at hazardous waste and emergency response sites and shall not be worn.

9.2 OHM Facilities and Shops - Personnel working at OHM shops and facilities have the option of wearing other types of ANSI approved safety work shoes and boots provided they are appropriate for the tasks being performed. The supervisor of the work area is responsible to decide what type footwear is appropriate.

10. HAND PROTECTION/GLOVES

OHM employees, subcontractors, and visitors will don appropriate gloves when engaged in any operation that presents a hazard to the hands.

10.1 Use - Appropriate work gloves shall be available for hand protection against heat and flame, cold, chemicals, petroleum products, corrosive materials, moisture, mechanical abrasion, electricity, and sharp and rough surfaces.

10.2 Selection - Glove selection of the appropriate hand protection shall be based on an evaluation of the performance characteristic of the hand protection relative to the task(s) to be performed, chemical concentration and properties, physical conditions present, duration of use, and the hazards and potential hazards identified. The type of work gloves used must be approved by the regional health and safety director/manager and designee as specified in the HASP for the particular task.

10.3 Electrical - When working on high voltage (480 volts and above) electrical equipment, electrically tested high voltage gloves will be worn. Leather protection will be worn over these gloves. (NOTE: Only authorized personnel are permitted to work on High Voltage electrical equipment).

## 11. PROTECTIVE CLOTHING

OHM employees, subcontractors, and visitors will don appropriate protective clothing when engaged in any operation that presents a hazard to the body.

11.1 Use - Appropriate clothing shall be available for body protection against heat and flame, cold, chemicals, petroleum products, corrosive materials, moisture, mechanical abrasion, electricity, and sharp and rough surfaces.

11.2 Selection - Clothing selection of the appropriate body protection shall be based on an evaluation of the performance characteristic of the body protection relative to the task(s) to be performed, chemical concentration and properties, physical conditions present, duration of use, and the hazards and potential hazards identified. The type of protective clothing used must be approved by the regional health and safety director/manager and designee and specified in the HASP for the particular task.

## 12. TOTALLY-ENCAPSULATING CHEMICAL PROTECTIVE SUITS

Totally-encapsulating chemical protective suits (Level A) shall be used in conditions where skin absorption of a hazardous substance may result in a substantial possibility of immediate death, immediate serious illness or injury, or impair the ability to escape.

12.1 Use - OHM will only use Level A protection when all other reasonable efforts of controlling employee exposure through engineering or administrative means are not possible.

12.2 Authorization - Level A protection may only be used after authorization of the regional health and safety director/manager has been granted.

12.3 Health and Safety Personnel - An appropriately experienced health and safety employee must be assigned to the project site where Level A is to be used. They must evaluate that the following items are ready:

- Communications
- Decontamination
- Emergency rescue procedures and personnel
- Emergency medical attention

12.4 OHM will discard and properly dispose of any Level A suit which has come in contact with chemical contaminants or sustained physical damage at least at the end of the project.

## 13. LOANING PERSONAL PROTECTIVE EQUIPMENT

OHM personnel should not loan OHM personal protective equipment to any client, subcontractor, or visitor personnel. If there are urgent circumstances, such as an emergency response where the equipment cannot be obtained elsewhere and chemical exposure is possible, OHM personnel can loan personal protective equipment such as respirators, protective clothing and other safety equipment to client personnel or personnel from other organizations. However because of the potential liability involved, approval of senior OHM management is required as well as the requirement that a representative of the company and the individual using the equipment execute an OHM Indemnification and Release Agreement. A copy of this agreement is attached in Appendix A.

13.1 Execution of Indemnification and Release Agreement - In general, the following will be required BEFORE the personal protective equipment may be loaned:

- The OHM Regional Vice President (or designee) must specifically authorize the loaning of personal protective equipment on the particular project.
- An authorized representative of the company whose personnel will use the equipment must sign the Indemnification and Release Agreement.
- The individual who will use the equipment must also sign the Indemnification and Release Agreement attesting to the fact that the individual is either experienced in the use of the equipment or has been given instruction on the safe use of the equipment and is medically qualified to wear the equipment.
- An OHM representative must also sign the form as a witness to the above.

13.2 Contractual Requirement - An indemnification and release agreement is not required if providing personal protective equipment to clients or regulatory personnel is a contractual requirement.

13.3 Exemptions - Hard hats, safety glasses, hearing protection, and protective clothing provided for cleanliness is exempted for the indemnification requirement. Instruction should be provided to the individual prior to wearing.

OHM Remediation Services Corp.
A Subsidiary of OHM Corporation

# APPENDIX A
# OHM REMEDIATION SERVICES CORP.
## INDEMNIFICATION AND RELEASE AGREEMENT FOR PERSONAL PROTECTION CLOTHING

FOR AND IN CONSIDERATION OF the use by the undersigned of property belonging to OHM Remediation Services Corp. (hereinafter referred to as "OHM") and which may include full-face mask respirators, self-contained breathing apparatus, and other equipment and supplies, and other good and valuable consideration, the undersigned , for himself and his successors, and assigns, does hereby release and discharge OHM, its officers, employees, agents, and subcontractors from any and all claims, actions, demands, damages, costs, loss of services, expenses, compensation, third-party actions, or suits, including attorneys fees, arising and resulting from the aforementioned use of property, equipment, or supplies belonging to OHM.

In addition, the undersigned, on behalf of his employer, principal, himself, and his successors, and assigns, agrees to release, save, and hold harmless, protect, indemnify, and defend OHM, and its officers, employees, agents, and subcontractors against any and all claims, actions, and expenses as above described, whether for bodily injury, property damage or destruction, or both, arising or resulting in any way from the use by the undersigned of property of OHM and agrees to save, hold harmless, protect, indemnify, and defend OHM against any such claims, actions, or expenses, referenced above, that might be brought against OHM by any third persons or the heirs, successors, executors or assigns of the undersigned.

The undersigned acknowledges by signing that he has carefully read this Agreement, understands the contents thereof, and has freely and voluntarily signed the same.

EXECUTED on _____, 19___.

1. OHM Regional Vice President (or designee) authorizing use of equipment:

   _____

2. CLIENT OR SUBCONTRACTOR REPRESENTATIVE AUTHORIZING EQUIPMENT USE:

   I authorize the individual(s) in 3. below to use OHM provided personal protective equipment

   Company Name_____

   Sign Name_____

   Print Name_____

   Title_____

3. INDIVIDUAL USING EQUIPMENT: I certify that I am familiar with the equipment and medically qualified to wear the equipment

   Company Name_____

   Sign Name_____

   Print Name_____

   NOTE: A continuation sheet can be used if more than one individual is to be certified to use equipment

4. OHM Representative Acknowledging Signatures:

   Sign Name_____

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## TABLE 1
## FACE PROTECTION SELECTION GUIDELINES

| Hazard | Protection |
|---|---|
| Flying fragments, objects, large chips, particles, sand, and dirt from chipping, grinding, machining, masonry work, riveting, and sanding | Safety spectacles or goggles Supplement with face shield for severe exposure |
| Chemical splash from corrosive and chemical handling, pressure washing operations | Goggles Supplement with face shield for severe exposure |
| Nuisance dust from woodworking, buffing, and general dusty conditions | Safety spectacles or goggles |
| Hot sparks from grinding operations | Safety spectacles or goggles Supplement with face shield for severe exposure |
| Molten metal from torch cutting operations | Shaded cutting goggles (see Table 3) and face shield |
| Welding operations | Safety spectacles and shaded welding hood (see Tables 2) |

OHM Remediation Services Corp.

## TABLE 2

## GUIDE FOR CUTTING SHADE NUMBERS

| Operation | Plate Thickness | Minimum Protective Shade |
|---|---|---|
| Gas Welding | | |
| Light | Under 1/8 | 4 or 5 |
| Medium | 1/8 to 1/2 | 5 or 6 |
| Heavy | over 1/2 | 6 or 8 |
| Oxygen Cutting | | |
| Light | Under 1 | 3 or 4 |
| Medium | 1 to 6 | 4 or 5 |
| Heavy | Over 6 | 5 or 6 |

## TABLE 3

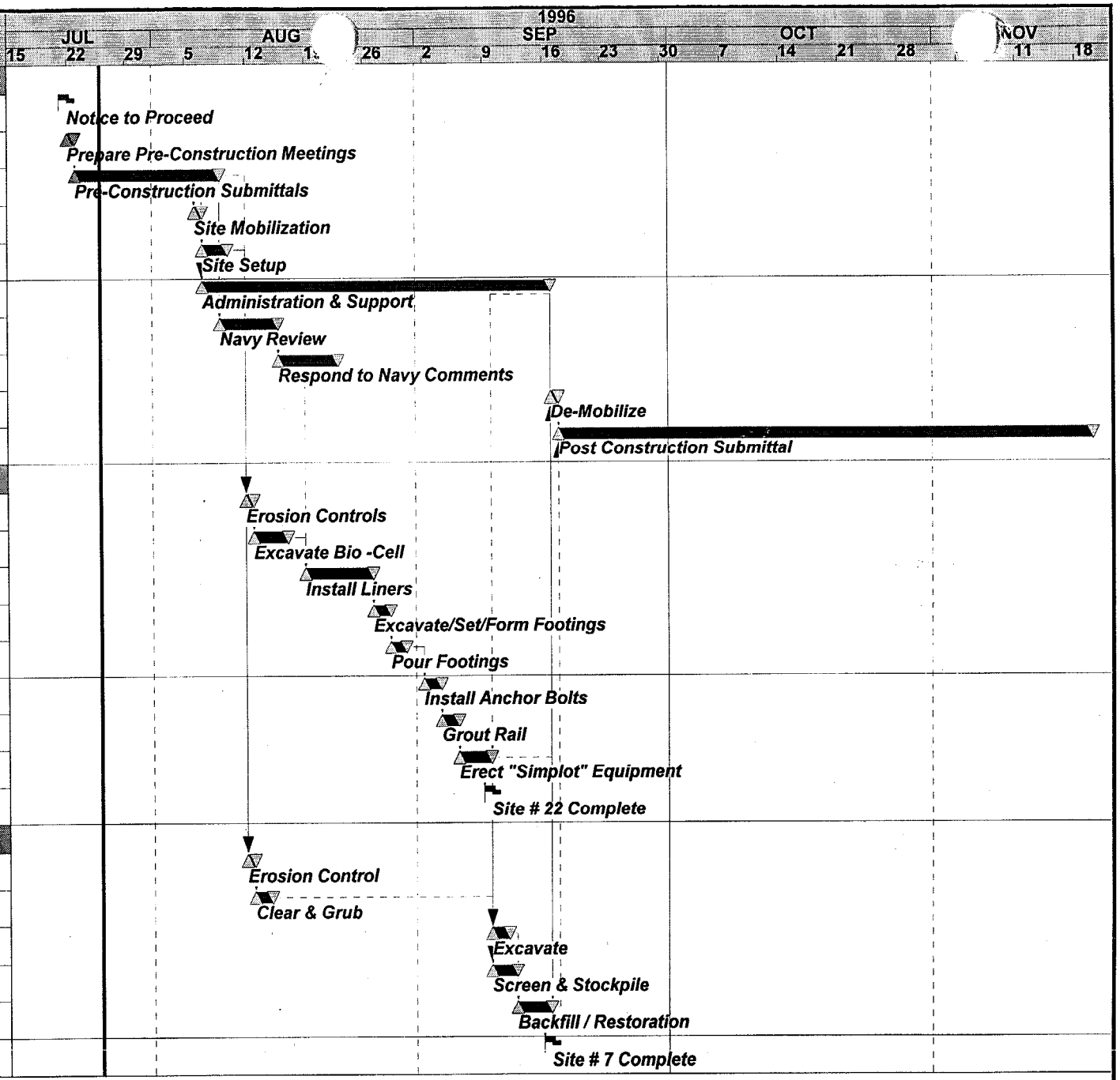
## GUIDE FOR WELDING SHADE NUMBERS

| Operation | Electrode Size 1/32 inch | Arc Current (A) | Minimum Protective Shade | Suggested* Shade No. (Comfort) |
|---|---|---|---|---|
| Shielding metal arc welding | Less than 3 | Less than 60 | 7 | — |
| | 3-5 | 60-160 | 8 | 10 |
| | 5-8 | 160-250 | 10 | 12 |
| | More than 8 | 250-550 | 11 | 14 |
| Gas metal arc welding and flux cored arc welding | | Less than 60 | 7 | — |
| | | 60-160 | 10 | 11 |
| | | 160-250 | 10 | 12 |
| | | 250-500 | 10 | 14 |
| | | 150-500 | 10 | 14 |
| Air carbon Air cutting | (Light) | Less than 500 | 10 | 12 |
| | (Heavy) | 500-1000 | 11 | 14 |
| Plasma arc welding | | Less than 20 | 6 | 6 to 8 |
| | | 20-100 | 8 | 10 |
| | | 100-400 | 10 | 12 |
| | | 400-800 | 11 | 14 |
| Plasma arc cutting | (Light) | Less than 300 | 8 | 9 |
| | (Medium) | 300-400 | 9 | 12 |
| | (Heavy) | 400-800 | 10 | 14 |
| Torch brazing | | — | — | 3 or 4 |
| Torch soldering | | — | — | 2 |
| Carbon arc welding | | — | — | 14 |

*As a rule of thumb, start with a shade that is too dark to see the weld zone. Then go to a lighter shade which gives sufficient view of the weld zone without going below the minimum. In oxyfuel gas welding or cutting where the torch produces a high yellow light, it is desirable to use a filter lens that absorbs the yellow or sodium line in the visible light of the (spectrum) operation.

# *APPENDIX D*
# *PROJECT SCHEDULE*

| Activity Description | Rem Dur | Early Start | Early Finish |
|---|---|---|---|
| **Support Activities** | | | |
| Notice to Proceed | 0 | 22JUL96A | |
| Prepare Pre-Construction Meetings | 0 | 22JUL96A | 22JUL96A |
| Pre-Construction Submittals | 10 | 23JUL96A | 08AUG96 |
| Site Mobilization | 1 | 06AUG96* | 06AUG96 |
| Site Setup | 3 | 07AUG96* | 09AUG96 |
| Administration & Support | 29* | 07AUG96 | 16SEP96 |
| Navy Review | 5 | 09AUG96 | 15AUG96 |
| Respond to Navy Comments | 5 | 16AUG96 | 22AUG96 |
| De-Mobilize | 1 | 17SEP96 | 17SEP96 |
| Post Construction Submittal | 45 | 18SEP96 | 19NOV96 |
| **Site #22** | | | |
| Erosion Controls | 1 | 12AUG96 | 12AUG96 |
| Excavate Bio -Cell | 4 | 13AUG96 | 16AUG96 |
| Install Liners | 6 | 19AUG96 | 26AUG96 |
| Excavate/Set/Form Footings | 2 | 27AUG96 | 28AUG96 |
| Pour Footings | 2 | 29AUG96 | 30AUG96 |
| Install Anchor Bolts | 2 | 02SEP96 | 03SEP96 |
| Grout Rail | 2 | 04SEP96 | 05SEP96 |
| Erect "Simplot" Equipment | 2 | 06SEP96 | 09SEP96 |
| Site # 22 Complete | 0 | | 09SEP96 |
| **Site # 7** | | | |
| Erosion Control | 1 | 12AUG96 | 12AUG96 |
| Clear & Grub | 2 | 13AUG96 | 14AUG96 |
| Excavate | 2 | 10SEP96 | 11SEP96 |
| Screen & Stockpile | 3 | 10SEP96 | 12SEP96 |
| Backfill / Restoration | 2 | 13SEP96 | 16SEP96 |
| Site # 7 Complete | 0 | | 16SEP96 |




Project Start 17JUN96
Project Finish 19NOV96
Data Date 26JUL96
Plot Date 26JUL96



Early Bar
Progress Bar

0113

Yorktown - DO#113
Naval Weapons Station
Sites # 7 & # 22

Sheet 1 of 1

OHM Remediation Services Corp.

K.Mech